

APPENDIX.



RECORD OF AURORAL PHENOMENA

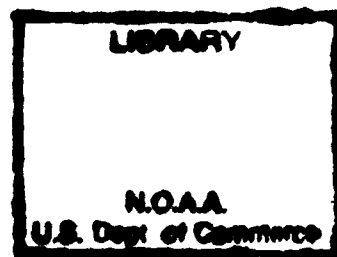
OBSERVED IN THE

HIGHER NORTHERN LATITUDES.

COMPILED BY

PETER FORCE.

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# **National Oceanic and Atmospheric Administration**

## **Environmental Data Rescue Program**

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## INTRODUCTORY LETTER.

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PROFESSOR JOSEPH HENRY,

*Secretary Smithsonian Institution.*

SIR: In compliance with your request, I place in your hands the collection of observations on the Aurora Borealis, which was made in great part while I was engaged, during the evening hours of relaxation, for several years prior to 1851, in the examination of another, and, to me, at the time, a more interesting subject. In the course of this investigation I met with so many notices of the Aurora, that I thought it worth the time it would take, to gather such of them as came within my reach without leaving the path over which I was travelling; it also occurred to me that such a collection, covering so broad a surface, might be useful in any investigation of the phenomenon, in so far at least, as it would furnish the means of a ready reference to many of the observations recorded by careful and competent observers.

The accompanying papers are my original notes, as they were made from time to time, from the later voyages, travels, and explorations in the northern regions, and particularly in the northern portions of North America. A list of the journals, &c., that I have gone over, which is added, will show how far my examination has extended.

You will perceive that very few of the Auroral observations I have given were made south of the fiftieth degree of north latitude.<sup>1</sup> North of that parallel they are quite full, though not entirely complete. Any omissions may, however, be easily supplied, as the name of the observer, the point of the first appearance and

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<sup>1</sup> In a work recently published by the State of New York, entitled "Results of a Series of Meteorological Observations made in Obedience to Instructions from the Regents of the University of Sundry Academies in the State of New York, from 1826 to 1850, inclusive, compiled by Franklin B. Hough, M.D., Albany, 1855," will be found a very full record of all auroras noticed in New York within the limits mentioned. I would also refer to various professed treatises on the subject, and especially to the volume on Auroras published in the Reports of the French "Commission Scientifique du Nord en Skandinavie, Laponie, &c."

the direction of the Aurora, the time of observation, and the locality, by parallel and meridian, are stated in every instance where it was found possible to do so.

I may venture to add that the observations here given, go far, as it appears to me, to establish the following points in regard to the Aurora Borealis :—

1. That in the higher northern latitudes it frequently first appears to the eastward, or to the westward, or to the southward of the observer, and hence is not strictly a north polar light.

2. That it is often at a low elevation, and sometimes near the surface of the earth, within the range of the vision of the observer.

3. That north of the 70th degree of north latitude it is less frequent and less brilliant than to the southward of that parallel.

4. That on and in the vicinity of the Atlantic Ocean and other open waters, it is most frequent and most brilliant.

5. That the season for its appearance is mostly between the autumnal and the vernal equinox.

6. That the time of its appearance is in most cases from six o'clock P. M. to midnight.

PETER FORCE.

WASHINGTON, May 1, 1856.



# RECORD OF AURORAL PHENOMENA

OBSERVED IN THE

## HIGHER NORTHERN LATITUDES.

Hartford, Ct.—Lat.  $41^{\circ} 45' 50''$  N. Long.  $72^{\circ} 40' 45''$  W. 1835, 1836. A. C. TWINING.

New Haven, Ct.—Lat.  $41^{\circ} 18' 30''$  N. Long.  $72^{\circ} 56' 45''$  W. do.

"The height of auroral phenomena is a subject which has divided philosophers. Some consider them as lying in the lower regions of the atmosphere; while others would elevate them beyond its supposed limits, or at least into its extreme upper regions.

It is my intention to prove, in three instances of late occurrence, that the latter opinion is the true one."—Am. Journ. Sc., XXXII, 217.

*Auroral Cloud of December 10, 1835.*—"Height above the surface of the earth, forty-two miles and one-third."—Ibid., p. 220.

*Auroral Arch of August 12, 1836.*—"Height above the surface of the earth, one hundred and forty-four and a half miles."—Ibid., p. 224.

*Auroral Arch of May 8, 1836.*—"Height, one hundred and sixty miles."—Ibid., p. 227.

N. B.—Height of aurora, December 10, 1835,  $42\frac{1}{3}$  miles.

Do. August 12, 1836,  $144\frac{1}{2}$  miles.

Do. May 8, 1836, 160 miles.

Columbia Co., N. Y.—Lat.  $42^{\circ} 30'$  N. Long.  $73^{\circ} 20'$  W. Autumn of 1806. W.

"To the Editor of the American Magazine. SIR: I do not recollect to have read, or heard, that any person had ever witnessed the exhibition of an *aurora borealis* in the daytime, and when the air was perfectly clear and the sky unclouded.

It is some years since I witnessed this, in company with many other persons; and having spoken of it to some friends, lately, in New York, I have been solicited to communicate the facts to the public. If you think them worth publishing, they are at your service.

I do not now precisely recollect the year, but it was about 1806, that I was employed, during several successive days, in surveying some lands near the northeast extremity of the County of Columbia, in the State of New York. The lands, comprising three or four farms, were to be subdivided among the heirs of a person then lately deceased, and were situated on some of the highest hills of that county. I was, of course, constantly attended by some eight, ten, and even twenty persons of the parties concerned, who all witnessed what I am going to relate.

It was late in autumn, and so cold that ice formed every night, and hardly all disappeared during the day. The air was very transparent, and, so far as I now recollect, none or but very few clouds to be seen. For several nights in succession, the *Northern Lights* shone pretty bright, in the valley where I slept, but disappeared in the morning.

On mounting these hills, at about 11 o'clock, we were surprised to witness the *streaks and flashes of the aurora borealis*, occupying the same place that they had done the night before, and so bright and luminous as to command our astonishment and admiration. The streaks were as clearly defined as during the night, and very considerably brighter than the field of the surrounding sky.

Not a cloud was to be seen, at least during two or three hours, while we narrowly watched the exhibition of this splendid phenomenon.

On the next and two or three of the succeeding days, we saw the same appearances at intervals; and through the intervening nights the aurora was quite bright.

I inquired at the time, and frequently afterwards, and could find no person who had noticed it in the day time, excepting those who had been on the hills in our party. Probably others may have observed it, and I regret that I had not sooner made public the result of our observations.

I know that these appearances could not be discovered from the valleys around us, at the time we saw them, because several of our party made the experiment.

I have only further to observe that, during this exhibition, the air was very clear and uncommonly bright for several days.

The streams of light from the north frequently shot up quite over our heads, and seemed to diverge every way, as from a point situated a very little below the visible horizon.

I shall be glad to learn if others have ever observed similar appearances under such circumstances, and to see the observations of the learned on this singular and interesting occurrence."—*Spafford's Am. Mag.*, I, No. 10, March 1816, p. 359.

N. B.—Streaks and flashes of the aurora at noonday. Not a cloud to be seen.

**Albany, N. Y.**—Lat.  $42^{\circ} 39' 3''$  N. Long.  $73^{\circ} 44' 49''$  W. April 19, 1831. Prof. J. HENRY.

"On the 19th of April, 1831, at 12 o'clock at noon, an observation was made with the Hansteen needle, the result of which differed only the fractional part of a second from the usual mean rate of this needle.

At 6 o'clock p. m. the same day, another observation was made with the same needle, and apparently under the same circumstances; but a remarkable change was now observed in the time of its making three hundred vibrations, indicating a great increase in the magnetic intensity of the earth. It was at first supposed that the needle had accidentally been placed contiguous to ferruginous substance; but, on a most careful investigation, nothing could be discovered which would tend in the least degree to explain the cause of the phenomenon.

At about 9 o'clock in the evening, or three hours after the above observation, an unusual appearance was noticed in the *southern part of the heavens*, which was shortly afterwards recognized as an arch of the aurora. It was about nine degrees in breadth, with the vertex of the arch twenty degrees above the horizon.

At this time, the northern part of the sky was covered with light fleecy clouds. At forty-five minutes past nine the clouds partially disappeared, and disclosed *the whole northern hemisphere entirely occupied with coruscations* of the aurora, shooting up past the zenith, and apparently all converging to the same point. The actual formation of a corona might probably have been observed, but for a dark cloud which remained stationary a little south of the zenith."—*Am. Journ. Science*, XXII, 146.

N. B.—At 9 p. m., noticed in the southern part of the heavens. At 9h. 45m. p. m., whole northern hemisphere entirely occupied with coruscations of aurora.

**Toronto, C. W.**—Lat.  $43^{\circ} 39' 35''$  N. Long.  $79^{\circ} 21' 35''$  W. May 8, 1836. R. H. BONNYCASTLE.

"At a quarter past nine o'clock on Sunday night, the eighth day of May (1836) in the present year, my attention, whilst regarding the heavens, was forcibly attracted to the sudden appearance *due east*, of a shining, broad column of light.

At first, as my window overlooks the Bay of Toronto and the low island which separates it from the lake, I took this singular *pillar of light* for the reflection from some steamboat on the clouds; but, having sought the open air on the gallery, which commands a full view of the bay and of Ontario, I was convinced that the meteor was an effluence of the sky, as I now saw it extend upwards, from the eastern water horizon line to the zenith, in a *well-defined, equal, broad column of white, strong light*, resembling in some degree that of the aurora, but of a steady brightness and unchanging body, whilst there were few or no clouds.

There was no moon, as on that day it rose at 2h. 4m., consequently it was dark, and, as the sky was not very cloudy, the meteor was seen to the greatest advantage as the night wore on.

It passed very slowly and bodily to the westward, continuing to occupy the space from the horizon to the zenith, until the upper part first faded slowly, and then the whole gradually disappeared, after it had reached nearly to *due northeast*.

The weather was cold, and there was no wind.

At twenty minutes past nine o'clock the pillar of light had vanished, but it immediately afterwards reappeared slightly in the horizon where it had been last seen [due N. E.], and in the mean time the constant auroral arch of the halos I have before mentioned, in Vol. XXX, 181, became visible in the northern horizon, and increased very rapidly in brilliancy, and at ten minutes to ten, gave so intense a glow to the sky that it was light enough to enable me to see the objects around distinctly as in pale moonlight. It was, in short, equal to the light of the moon at the end of the second quarter.

The auroral arch rose very high on this occasion, and then flattened, and at ten the double arch I have already described was peculiarly beautiful, the darkness under it being singularly grand."—*Am. Journ. Sci.*, XXXII, 398.

N. B.—A well-defined, equal, broad column of white, bright light. Appeared due east.

**Port Henry, two miles north of Crown Point, Lake Champlain.**—Lat. 44° 5' N. Long. 78° 30' W. August 18, 1886. W. C. REDFIELD.

"On the evening of the 18th (of August, 1886), we were entertained with a brilliant exhibition of the Aurora Borealis, which, between 7 and 8 p. m., shot upward in rapid and luminous coruscations from the *northern half of the horizon*, the whole converging to a point apparently fifteen degrees south of the zenith.

This appearance was succeeded by luminous vertical columns or pencils, of the color, alternately, of a pale red and a peculiar blue, which were exhibited in great beauty."—*Am. Journ. Sci.*, XXXIII, 302.

N. B.—Rapid and luminous coruscations from the northern half of the horizon. Succeeded by luminous vertical columns or pencils, colored, alternately, with red and a peculiar blue.

**St. John's, Newfoundland.**—Lat. 47° 33' 33" N. Long. 52° 45' 10" W. BONNYCASTLE.

"This phenomenon, but little investigated, and less known, is generally supposed to be the most perfect the nearer we approach the arctic circle in our hemisphere; but I have long doubted that popular opinion.

It may be more permanent in the higher latitudes, compensating for the single night of half a year's duration; but I believe, for I have seen it in very high latitudes, when a young man, in the Northern Seas, that it is more splendid in Western Canada and in Newfoundland, than nearer to the pole. There are circumstances connected with its appearance in the latter country, which tend to upset another generally received notion.

It has been seen here, at St. John's, visibly close to the observer. One gentleman saw it *between his house and Quiddy-Biddy Pond*, a lake about a mile long, near the south bank of which his dwelling is erected, on a slope of Signal Hill.

Another gentleman, equally to be depended upon, and very fond of noticing extraordinary appearances, saw it in another situation, near the quarters I occupy, *equally close to him*; and it always appears to me here, as if it was not very far off.

The peculiar humid atmosphere of the east coast, and the vicinage of the ocean, between which and the city there is a lofty barrier of rocky hills, all conduce to render the belief in this new appearance reasonable."—Bonnycastle, I, 359.

N. B.—It has been seen at St. John's visibly close to the observer.

**Cedar Lake.**—Lat.  $53^{\circ} 12' 59''$  N. Long.  $100^{\circ} 10' 49''$  W. October 13, 1819. FRANKLIN.

"Cross Lake is extensive, running towards the N. E., it is said, for forty miles. We crossed it at a narrow part, and, pulling through several winding channels, formed by a group of islands, entered Cedar Lake, which, next to Lake Winnipeg, is the largest sheet of fresh water we had hitherto seen. Ducks and geese resort hither in immense flocks in the spring and autumn. These birds were now beginning to go off, owing to the muddy shores having become quite hard through the nightly frosts.

At this place the Aurora Borealis was extremely brilliant in the night, its coruscations darting, at times, *over the whole sky*, and assuming various prismatic tints, of which the violet and yellow were predominant."—Franklin, I, 46.

N. B.—Extremely brilliant. Over the whole sky.

**Lake Winnipeg**—Lat.  $53^{\circ} 45' 58''$  N. Long.  $98^{\circ} 49' 58''$  W. October 8, 1819. FRANKLIN.

"We left Norway House soon after noon, and the wind being favorable, sailed along the northern shore of Lake Winnipeg the whole of the ensuing night; and on the morning of the 8th landed on a narrow ridge of sand, which, running out twenty miles to the westward, separates Limestone Bay from the body of the lake.

From Norwegian Point to Limestone Bay the shore consists of high clay cliffs, against which the waves beat with violence during strong southerly winds. When the wind blows from the land, and the waters of the lake are low, a narrow sandy beach is uncovered, and affords a landing place for boats. The shores of Limestone Bay are covered with small fragments of calcareous stones.

During the night the Aurora Borealis was quick in its motions, and various and vivid in its colors."—Franklin, I, 44.

N. B.—Quick in its motions. Various and vivid in its colors.

**Cumberland House.**—Lat.  $53^{\circ} 56' 40''$  N. Long.  $102^{\circ} 16' 41''$  W. Nov. 15, 1819. FRANKLIN.

"The sky had been overcast during the last week; the sun shone forth once only, and then not sufficiently for the purpose of obtaining observations.

Faint coruscations of the Aurora Borealis appeared one evening, but their presence did not in the least affect the electrometer or the compass."—Franklin, I, 50.

November 24, 1819.—"The Aurora Borealis had been faintly visible for a short time the preceding evening."—Ibid., 51.

November 28, 1819.—"The Aurora Borealis was twice visible, but faint on both occasions. Its appearance did not affect the electrometer, nor could we perceive the compass to be disturbed." Ibid., 51.

Cumberland House.—Lat.  $53^{\circ} 56' 40''$  N. Long.  $102^{\circ} 16' 41''$  W. October 23, 1819, to June 13, 1820. Hood.

"The most material information we had obtained at this period regarded the height of the aurora from the earth.

The following is the result of the observations that were made at the Basquian Hill, and at the same time, by Dr. Richardson, at Cumberland House. The instruments used for the purpose were two small wooden quadrants, revolving on pivots and furnished with plummets. Our chronometers were previously regulated; though great accuracy was not necessary in this particular, as the arches of the aurora are sometimes stationary for many minutes.

On the 2d of April, the altitude of a brilliant beam was  $10^{\circ}$ , at 10h. 1m. p. m., at Cumberland House. Fifty-five miles S. S. W., it was not visible. As the trees at the latter station rose about  $5^{\circ}$  above the horizon, it may be estimated that the beam was *not more than seven miles from the earth*, and twenty-seven from Cumberland House.

On the 6th of April, the aurora was, for some hours, in the zenith at that place, forming a confused mass of flashes and beams; and in lat.  $53^{\circ} 22' 48''$  N., long.  $108^{\circ} 7' 17''$  W., it appeared in the form of an arch, stationary about  $9^{\circ}$  high, and bearing N. by E. It was therefore *seven miles from the earth*.

On the 7th of April, the aurora was again in the zenith, before 10 p. m., at Cumberland House, and in lat.  $53^{\circ} 36' 40''$  N., and long.  $102^{\circ} 31' 41''$  W. The altitude of the highest of two concentric arches at 9h. p. m. was  $9^{\circ}$ ; at 9h. 30m. p. m. it was  $11^{\circ} 30'$ ; at 10h. p. m.,  $15^{\circ}$ —its centre always bearing N. by E. During this time, it was *between six and seven miles from the earth*. After 10h. p. m., it covered the sky at Cumberland House, and passed the zenith at the other place.

These observations are opposed to the general opinion of meteorologists; they are nevertheless facts. We have sometimes seen an attenuated aurora *flashing across*  $100^{\circ}$  of the sky in a single second; a quickness of motion inconsistent with the height of sixty or seventy miles, the least which has hitherto been ascribed to it. This kind of aurora is not brighter than the Milky Way, and resembles sheet-lightning in its motions.

For the sake of perspicuity, I shall describe the several parts of the aurora, which I term beams, flashes, and arches.

The *Beams* are little conical pencils of light, ranged in parallel lines, with their pointed extremities towards the earth, generally in the direction of the dipping needle.

The *Flashes* seem to be scattered beams approaching nearer to the earth, because they are similarly shaped and infinitely larger. I have called them flashes because their appearance is sudden, and seldom continues long.

When the aurora first becomes visible, it is formed like a rainbow, the light of which is faint, and the motion of the beams undistinguishable. It is then in the horizon.

As it approaches the zenith, it resolves itself at intervals into beams, which, by a quick undulating motion, project themselves into wreaths, afterwards fading away, and again brightening, without any visible expansion or concentration of matter. Numerous flashes attend in different parts of the sky.

That this mass, from its short distance above the earth, would *appear like an arch* to a person situated at the horizon, may be demonstrated by the rules of perspective, supposing its parts to be nearly equidistant from the earth. An undeniable proof of it, however, is afforded by the observations of the 6th and 7th of April, when the aurora which filled the sky at Cumberland House, from the northern horizon to the zenith, with wreaths and flashes, assumed the shape of arches at some distance to the southward.

But the aurora does not always make its first appearance as an arch. It sometimes rises from a confused mass of light in the east or west, and crosses the sky towards the opposite point, exhibiting wreaths of beams, or coronæ boreales, in its way.

An arch, also, which is pale and uniform at the horizon, passes the zenith without displaying any irregularity or additional brilliancy; and we have seen three arches together, very near the northern horizon, one of which exhibited beams and even colors, but the other two were faint and uniform.

On the 7th of April, an arch was visible to the southward, exactly similar to that in the north, and it disappeared in fifteen minutes. It had probably passed the zenith before sunset.

The motion of the whole body of aurora is from the northward to the southward, at angles not more than  $20^\circ$  from the magnetic meridian. The centres of the arches were as often in the magnetic as in the true meridian.

The colors do not seem to depend on the presence of any luminary, but to be generated by the motion of the beams, and then only when that motion is rapid, and the light brilliant. The lower extremities quiver with a fiery red color, and the upper with orange. We once saw violet in the former."—Franklin, I, 541.

N. B.—Height of the aurora.

**Cumberland House.**—Lat.  $58^\circ 56' 40''$  N. Long.  $102^\circ 16' 41''$  W. Winter of 1819–20. Hood.

"The number of auroræ visible in September was 2; in October 3; in November 3; in December 5; 1819: in January 5; in February 7; in March 16; in April 15; in May 11; 1820.

Calm and clear weather was the most favorable for observation; but it is discernible in cloudy weather, and through mists. We could not perceive that it affected the weather. The *magnetic needle, in the open air, was disturbed by the aurora*, whenever it approached the zenith. Its motion was not vibratory, as observed by Mr. Dalton; and this was, perhaps, owing to the weight of the card attached to it. It moved slowly to the east or west of the magnetic meridian, and seldom recovered its original direction in less than eight or nine hours. The greatest extent of its aberration was  $45'$ .

A delicate electrometer, suspended at the height of fifty feet from the ground, was never perceptibly affected by the aurora, nor could we distinguish its *rustling noise*, of which, however, such strong testimony has been given to us, that no doubt can remain of the fact.

The conclusions to be drawn from the above will be found in the observations for the winter of 1820."—Franklin, I, 543.

(At Cumberland House, the aurora always to the north of east and west.)

N. B.—Number of auroræ noticed. Magnetic needle disturbed. Electrometer never affected. No rustling noise distinguished.

**Cumberland House.**—Lat.  $58^\circ 56' 40''$  N. Long.  $102^\circ 16' 41''$  W. Variation  $17^\circ 17' 31''$  E. October 23, 1819, to June 30, 1820. Hood.

"From the 23d of October to the 25th of November, the aurora was not visible, or it did not appear before 1 a. m.

November 26th. At 1 a. m., an aurora, arched like a rainbow, about  $20^\circ$  high; centre bearing north; color pale yellow, faint. At 8 p. m., a very faint arch, centre north.

December 6th. At 10 p. m., a faint-arched aurora, centre north by east.

8th. A similar aurora, centre north, at 10 p. m.

9th. At 11 p. m., an arched aurora, centre north; color light yellow, very bright.

12th. At 8 p. m., an arched aurora, centre north; color light yellow, faint."—Franklin, I, 543.

**Upper Portage, near Knee Lake.**—Lat.  $55^\circ 14' 2''$  N. Long.  $94^\circ 21' 54''$  W. September 24, 1819. FRANKLIN.

"At seven in the morning of the 24th, we crossed the Long Portage, where the woods, having caught fire in the summer, were still smoking.

We afterwards crossed the Second, or Swampy Portage, and in the evening encamped on the Upper Portage, where we were overtaken by an Indian bringing an answer from Governor Williams to a letter I had written to him on the 15th, in which he renewed his injunctions to the gentlemen of the boats accompanying us, to afford us every assistance in their power.

The Aurora Borealis appeared this evening in a *N. W. and S. E.* direction."—Franklin, I, 35.

**Fort Isle la Crosse.**—Lat.  $55^{\circ} 25' 35''$  N. Long.  $107^{\circ} 51'$  W. March 4, 1820. FRANKLIN.

"We witnessed the Aurora Borealis very brilliant for the second time since our departure from Cumberland" (on the 18th of January, 1820).—Franklin, I, 126.

N. B.—Very brilliant for the second time since 18th January.

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**Off Cape Farewell.**—Lat.  $56^{\circ} 17'$  N. Long.  $42^{\circ} 51''$  W. October 21, 1852. INGLESFIELD.

"Weather exceedingly disturbed. Aurora Borealis frequently most brilliant."—Inglesfield, p. 205.

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**Methye River.**—Lat.  $56^{\circ} 26' 30''$  N. Long.  $109^{\circ} 52' 54''$  W. January 23, 1837. SIMPSON.

"On the 23d, we started at 3 a. m. Some time before daylight there was a magnificent display of the *Aurora Borealis*, commencing with an arch of singular lustre in the north, which suddenly flashed up towards the zenith, and represented the interior of a stupendous cone, the apex and upper part being of a bright yellow hue, while the lower assumed a very rich carmine color. I had scarcely time to admire this resplendent phenomenon when it disappeared."—Simpson, p. 57; *Ibid.*, Life, p. 210.

- N. B.—1. Arch of singular lustre in the north.  
 2. Suddenly flashed up towards the zenith.  
 3. Represented the interior of a stupendous cone.
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**At Sea.**—Lat.  $57^{\circ}$  N. Long.  $49^{\circ}$  W. Monday, October 2, 1820. PARRY.

"After 10 p. m. this night, the Aurora Borealis appeared at times in almost every part of the heavens, but most constantly in the southern quarter.

It consisted of no distinct figure, either arch or pencils, but of a generally diffused white light, illuminating the atmosphere at times quite as much as the moon does when six or seven days old.

This phenomenon occurred almost every night during our passage across the Atlantic, rendering them extremely light, even when the weather was cloudy; just in the same manner that the moon does although her disk is not visible. When the weather was clear, it most frequently resembled the light of that luminary when issuing from behind a dark cloud."—Parry, I, 306.

- N. B.—1. At times, in almost every part of the sky.  
 2. Most constantly in southern quarter.  
 3. Consisted of no distinct figure.  
 4. But of generally diffused white light.
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**Near York Fort, Hudson's Bay.**—Lat.  $57^{\circ} 2'$  N. Long.  $93^{\circ}$  W. February, 1747. CLERK OF THE CALIFORNIA.

"When we came into the winter harbor, and during the winter, the Aurora Borealis seldom appeared from the northwest or northeast, but generally from the northward of our zenith shooting south, and at the same time another light, from the southwest, streaking towards the zenith; the former from the bay, the latter over and according to the course of Port Nelson River.

There was for several successive nights, and at various times in the winter, over Hay's Island, a broad, settled gleam of light, much resembling the Milky Way (only of a brighter color and somewhat broader), that reached from the northward of our zenith, and seemingly joined almost with the horizon.

The Aurora Boreales were something more frequent in the winter than in the summer months, but

were not in winter always apparent on every clear or starlight night."—Voyage to Hudson's Bay, II, 11.

- N. B.—1. Seldom appeared from the N. W. or N. E., but generally from the N.  
 2. At the same time, another light from the S. W., streaking towards the zenith.  
 3. Aurora something more frequent in winter than the summer months.

**Near York Factory.**—Lat.  $57^{\circ} 2' N.$  Long.  $93^{\circ} W.$  Winter of 1746–7. ELLIS.

"The air of this country is never, or, at least, is very seldom clear. In the spring and fall of the year there are heavy wet fogs, and in the winter the air is full of an infinite number of icy spicula, that are visible to the naked eye, especially if the wind be northerly or easterly, and the frost severe; the reason of it is this, wherever the water is clear of ice; in the winter there arises a very thick vapor, commonly called frost smoke; this vapor freezing is driven by the wind in the form we see it.

All the beginning of winter, Port Nelson River was unfroze in the stream; this lying to the northward of us, the wind blowing from that point, constantly brought with it showers of these icy particles, which disappeared when it was froze.

Hence, also, frequent mock suns and halos about the moon and sun, very luminous and beautifully tinged, with all the colors of the rainbow, are very common. Six of these parhelia, or mock suns, I have seen at one time, which to us was very surprising."—Ellis, p. 171.

"The true sun also rises and sets there with a large cone of yellow light, perpendicular to it; and no sooner does it disappear than the *Aurora Borealis* spreads a thousand different lights and colors over the whole concave of the sky, with so resplendent a beauty that even the full moon does not efface their lustre. But, if the moon does not shine, these lights are much more apparent, for one may then read distinctly by them, and the shadows of objects are seen upon the snow, tending to the southeast, as the light shines brightest in the opposite quarter where it rises, and whence the rays thereof are propagated over the whole face of the sky, with a waving kind of motion.

The stars seem in this country to burn with a fiery redness, especially those near the horizon, which strongly resemble a fire, or a ship's light at a distance."—Ibid., p. 172.

- N. B.—1. One may read distinctly by the aurora, when the moon does not shine.  
 2. The light shines brightest in the N. W.  
 3. Whence rays are propagated over the sky.

**York Fort.**—Lat.  $57^{\circ} 2' N.$  Long.  $93^{\circ} W.$  1772–1780. UMFREVILLE.

"[York Fort, where I resided eight years, lies in the lat. of  $57^{\circ} 2' N.$ , long.  $93^{\circ} W.$  from London, as determined by Mr. Philip Turner, a gentleman employed by the company to make astronomical observations within the limits of Hudson's Bay. Page 11.]

In the coldest weather, the atmosphere is the most serene. Throughout the day, the air is generally filled with icy particles, which are small beyond conception. These are driven about in the direction of the wind, and adhere to everything which happens to be in the way of their progress. In the evening, the stars begin to shine with refulgent lustre, and the contemplative mind is struck with reverence and awe to see the *Aurora Borealis* darting, with inconceivable velocity to all parts of the heavens.

Very few winter nights pass in Hudson's Bay without this phenomenon making its appearance. Sometimes the irradiations are seen of a very bright red, at other times of a pale, milky color, undulating with every beauty it is possible to conceive or describe."—Umfreville, p. 23.

- N. B.—1. In coldest weather, atmosphere most serene.  
 2. Very few winter nights without the aurora.



**York Factory.**—Lat.  $57^{\circ} 2' N.$  Long.  $92^{\circ} 40' W.$  Aug. 31 to Sept. 28, 1814. CHAPPELL.

"During our stay in Hudson's Bay, and upon our voyage home from thence, our nights were constantly illuminated by the most vivid and brilliant coruscations of the Aurora Borealis.

Its appearance was very different from that which I have seen in more southern latitudes; resembling continual jets of meteoric fire from the *northern part of the horizon*, which, after darting upwards in long streamers towards the zenith, suddenly collapsed and receded, falling back, in zigzag serpentine lines, with diminished splendor; and ultimately dying away and vanishing from the sight, being succeeded by other jets as beautiful as the first."—Chappell, p. 136.

N. B.—1. Nights constantly illuminated by most brilliant coruscations.

2. Very different from that seen in more southern latitudes.

**At Sea.**—Lat.  $57^{\circ} 30' N.$  Long.  $45^{\circ} W.$  Tuesday, October 3, 1820. PARRY.

"On the 3d, we observed a more brilliant display than usual of this phenomenon. It appeared at nine p. m. in various parts of the heavens, from *E. N. E.*, round by *S.*, to *W. by N.*, principally consisting at first of many detached luminous patches like clouds, irregularly scattered about, and shifting frequently, though not very rapidly, from place to place. From *W. by N.* over to the *S. S. E.*, and passing a few degrees to the southward of the zenith, there soon appeared a broad band of light, having a tendency to arch; and the light of which this consisted appeared to come from the west towards the east.

In the *E. N. E.* quarter, there was a luminous appearance, distinct from the rest, at about  $15^{\circ}$  or  $20^{\circ}$  of altitude, exactly resembling the light of the moon behind a dusky cloud, except that at times vivid coruscations shot upwards from it towards the zenith.

At a quarter past ten the phenomenon suddenly became much more brilliant, its general position and character remaining, however, nearly as before. It still appeared chiefly to the southward of the zenith, the arch-like appearance continuing with increased splendor, and accompanied for about a quarter of an hour by a beautifully waving light, of the rapidity and magnificence of which it is impossible to convey any adequate idea. The motion of this light reminded me of the contortions of a snake, except that its velocity was often so great that the eye could with difficulty follow it. The most intense part was of a pale greenish color; the rest nearly white.

The arch, which before had been stationary, at one time shifted its position, by appearing, as it were, to turn up its legs so as to form a part of a circle seen in perspective in the south, parallel to the horizon. The luminous patch, or cloud, in the *E. N. E.* increased also very much in brightness at the same time, emitting more vivid coruscations, but continuing, as before, quite distinct from the rest of the phenomenon.

This Aurora, when brightest, gave nearly as much light as that of a full moon. There could not be the smallest doubt that it *dimmed*, and even sometimes *altogether obscured*, the stars over which it passed. We particularly remarked that, wherever there was a broad stream of its light stationary for some time in any part of the heavens, it produced exactly the effect of a curtain; for we could only distinguish stars of the first and second magnitude *through* it, while those of inferior brilliancy were visible in great numbers by the side of it.

In this, as in several previous instances, the Aurora appeared very near us, though it was evidently higher than some clouds which were passing, as might readily be distinguished by the latter intercepting a part of its light.

The electrometer was tried during the most brilliant part of the phenomenon, but neither on this or on any other occasion, in crossing the Atlantic, did the gold leaf give any indication of electricity; nor was the *magnetic needle* in the slightest degree affected.

The arch-like appearance above described was not bisected by the magnetic meridian, but by magnetic *N. E.* and *S. W.*

At a quarter before eleven, the light became less brilliant, and spread more to the northward, and then gradually disappeared before midnight."—1 Parry, 306.

- N. B.—1. Gave nearly as much light as that of a full moon.  
 2. Dimmed, and sometimes almost obscured the stars.  
 3. It appeared generally to the south of the zenith.  
 4. Did not affect the magnetic needle.  
 5. Appeared very near.
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**At Sea.**—Lat.  $57^{\circ} 30'$  N. Long.  $45^{\circ}$  W. Tuesday, October 3, 1820. FISHER.

"The Aurora Borealis appeared very beautifully from nine till eleven o'clock this evening, forming an arch extending from east to west across the zenith; almost the whole of the *south side* of the hemisphere was indeed illumined by it, but it was not seen to the northward, except near the zenith.

It presented at different times a beautiful display of some of the prismatic colors, particularly the red, orange, yellow, and green; lake was also a predominant color in some parts occasionally. With respect to the different forms that it assumed, and its various movements, I consider it impossible to give a correct idea of them by words. It appeared sometimes in immense sheets of light, moving rapidly along the surface of the sky; and at other times it darted in straight columns, from different parts of the sky towards the zenith. The most remarkable appearance, however, that it presented, was a sort of serpentine motion that it had at one time, from west to east, across the zenith.

The electrometer was tried, but it *was not affected, nor did we hear any noise* such as has been said to be produced by this phenomenon.

Whether the Aurora Borealis *dims the light of the stars or not*, I can hardly pretend to say; but I can affirm this much, that I *could see very plainly*, in the thickest part of it, the four small stars forming the diamond-shaped figure in the constellation of the Dolphin, from which I imagine that a great part of the dimness that appears to be occasioned, is owing to the stars and Aurora Borealis being nearly of the same color."—Fisher, pp. 288–89.

- N. B.—1. Whole southern hemisphere illuminated.  
 2. At times, displayed prismatic colors.  
 3. Electrometer not affected.  
 4. Heard no noise.  
 5. Small stars seen plainly through thickest part of it.
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**At Sea.**—Lat.  $58^{\circ} 12'$  N. Long.  $49^{\circ} 15'$  W. June, &c., 1746. CLERK OF THE CALIFORNIA.

"We had the Aurora Borealis some nights this month, as we had had at times from the 28th of June, when to the *westward and southward of Farewell*.

The Aurora Borealis in June was from the *southeast, then shifting round to the east*. Its appearance was like to that of a small yellow cloud, about forty degrees above the horizon, which soon shot out a stream towards the zenith, which stream consisted of a variety of colors—black, blue, flame-color, &c.—continually vibrating; and, after several emanations, which lasted for a small time, would collect and fold itself into the cloud, and then shoot out again.

The color of the others, in general, which we saw both in the bay and also after our arrival in Hays's River, was a yellow or buff color, with large streams shooting out, and then contracting, as we often see them in England, excepting some in the beginning of November, which were like that in June.

The radii of the Aurora Borealis which we had in the bay, shot from the *southward*."—Voyage to Hudson's Bay, II, 11.

**At Sea: Atlantic.**—Lat.  $58^{\circ} 30' N.$  Long.  $44^{\circ} 30' W.$  September 24, 1825. PARRY.

"The next brilliant display of this beautiful phenomenon which we now witnessed, and which far surpassed anything of the kind observed at Port Bowen, occurred on the night of the 24th of September, in latitude  $58\frac{1}{2}^{\circ}$ , longitude  $44\frac{1}{2}^{\circ}$ .

It first appeared in a (true) east direction, in detached masses, like luminous clouds of yellow or sulphur-colored light, about three degrees above the horizon. When this appearance had continued for about an hour, it began, at nine p. m., to spread upwards, and gradually extended itself into a narrow band of light, passing through the zenith and again downwards to the western horizon.

Soon after this the streams of light seemed no longer to emanate from the eastward, but from a fixed point about one degree above the horizon on a true west bearing. From this point, as from the narrow point of a funnel, streams of light, resembling brightly-illuminated vapor or smoke, appeared to be incessantly issuing, increasing in breadth as they proceeded, and darting with inconceivable velocity, such as the eye could scarcely keep pace with, upwards towards the zenith, and in the same easterly direction which the former arch had taken. The sky immediately under the spot from which the light issued, appeared, by a deception very common in this phenomenon, to be covered with a dark cloud, whose outline the imagination might at times convert into that of the summit of a mountain, from which the light proceeded like the flames of a volcano. The streams of light, as they were projected upwards, did not consist of continuous vertical columns or streamers, but almost entirely of separate though constantly-renewed masses, which seemed to roll themselves laterally onward, with a sort of undulating motion, constituting what I have understood to be meant by that modification of the Aurora called the 'merry dancers,' which is seen in beautiful perfection at the Shetland Islands. The general color of the light was yellow, but an orange and a greenish tinge were at times very distinctly perceptible, the intensity of the light and colors being always the greatest when occupying the smallest space. Thus the lateral margins of the band or arch seemed at times to roll themselves inwards so as to approach each other, and in this case the light just at the edges became much more vivid than the rest. The intensity of light during the brightest part of the phenomenon, which continued three-quarters of an hour, could scarcely be inferior to that of the moon when full.

We once more remarked, in crossing the Atlantic, that the Aurora often gave a great deal of light at night, even when the sky was entirely overcast, and it was on that account impossible to say from what part of the heavens the light proceeded, though it was often fully equal to that afforded by the moon in her quarters.

This was rendered particularly striking on the night of the 5th of October, in consequence of the frequent and almost instantaneous changes which took place in this way, the weather being rather dark and gloomy, but the sky at times so brightly illuminated, almost in an instant, as to give quite as much light as the full moon similarly clouded, and enabling one distinctly to recognize persons from one end of the ship to the other.

We did not, on any occasion, perceive the compasses to be affected by the Aurora Borealis."—  
3 Parry, 170-71-72.

N. B.—1. First appeared in the (true) east.

2. Very brilliant.

3. On no occasion perceived the compasses affected.

**Fort Chippewyan.**—Lat.  $58^{\circ} 43' 38'' N.$  Long.  $111^{\circ} 18' 20'' W.$  April, 1820. FRANKLIN.

"The month of April commenced with fine and clear, but extremely cold weather; unfortunately, we were still without a thermometer, and could not ascertain the degrees of temperature.

The coruscations of the Aurora were very brilliant almost every evening of the first week, and were generally of the most variable kind.

On the 3d they were particularly changeable. The first appearance exhibited three illuminated beams issuing from the horizon in the northeast and west points, and directed towards the zenith;

in a few seconds these disappeared, and a complete circle was displayed, bounding the horizon at an elevation of fifteen degrees.

There was a *quick lateral motion* in the attenuated beams of which this zone was composed. Its color was a pale yellow, with an occasional tinge of red."—1 Franklin, 143.

"On the 17th and 19th the Aurora appeared very brilliant in patches of light, bearing *N. W.*"—Ibid., p. 144.

May 2, 1820.—"On the 2d the Aurora faintly gleamed through very dense clouds."—Ibid., p. 145.

June 16, 1820.—"On the evening of the 16th the Aurora Borealis was visible, but after that date the nights were too light for our discerning it."—Ibid., p. 162.

N. B.—1. Three illuminated beams in the N. E. and W. points.

2. A complete circle bounding the horizon,  $15^{\circ}$  high.

3. A quick lateral motion.

**At Sea: Atlantic Ocean.—March 29, 1817. O'REILLY.**

March 29, 1817.—"At 8 p. m., the *electric coruscations* suddenly appeared, running about at thirty degrees above the horizon, ascending in a perpendicular direction from a base in a rapid succession of brassy-yellow flames, from *W. to E.*, and soon died away.

Immediately after, from the westward there slowly extended upwards to the zenith four faintly-marked radii, which diverged as they ascended; two, more approximating to each other and nearly of equal breadth throughout. One only remained, stretching in a magnificent arch over the zenith, embracing the horizon east and west, and of a splendor exceedingly faint: it might, on hasty observation, be supposed a *cirrus*."—O'Reilly, p. 28.

N. B.—1. First appearance—yellow flames from *W. to E.*

2. Magnificent arch over the zenith embracing the horizon *E. and W.*

March 30.—"At 9½ p. m., the coruscations appeared again from *northwest*; and, in the midst of the stunning hurly, I could not resist noticing their activity. Imagination would say, that truly the spirit of the storm was abroad in all his majesty. The account of the lights, immediately noted, may be of interest to some of my readers."—Ibid., p. 29.

N. B.—Coruscations from northwest.

**Near Davis's Strait.—April, 1817. O'REILLY.**

April 8, 1817.—"Lights very vivid, restless, and playing from every point towards the star Benetnach, as to a centre of afflux."—O'Reilly, p. 31.

April 16.—"The lights, between 10 and 11 p. m., were exceedingly splendid, and seemed to make Benetnach a centre, but moving to *N. E.*"—Ibid., p. 33.

**At Sea.—Lat.  $59^{\circ}$  N. Long.  $50^{\circ}$  W. October 8, 1818. ROBERTSON.**

"At eight in the evening, observed the Aurora very bright on the *true east* quarter, shooting beautiful rays in bundles from the horizon to the altitude of  $60^{\circ}$ ; this was soon obscured by squalls of snow and sleet. From nine to twelve the Aurora was seen in every part of the heavens shooting streams of light in every direction; the most luminous appearing from *north by west* to *west by north*, true bearings."—1 John Ross (Robertson), App., cxxii.

N. B.—1. At 8 p. m., very bright in true *E.* quarter.

2. From 9 to 12, in every part of the heavens; the most luminous appearing from *N. by W.* to *W. by N.*

**At Sea.**—Lat.  $59^{\circ} 58'$  N. Long.  $59^{\circ} 53'$  W. August 4, 1819. FRANKLIN.

"At nine p. m., brilliant coruscations of the Aurora Borealis appeared, of a pale ochre color, with a slight tinge of red, in an arched form—crossing the zenith from *N. W.* to *S. E.*, but afterwards they assumed various shapes, and had a rapid motion."—Franklin, I, 12.

N. B.—1. Arch crossing zenith from *N. W.* to *S. E.*

2. Various shapes; rapid motion.

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**Hoaruk (Greenland).**—Lat.  $59^{\circ} 59'$  N. Long.  $44^{\circ} 36'$  W. March 27, 1829. GRAAH.

"At eight o'clock this evening, we saw an Aurora Borealis in the form of a luminous arch stretching from *N. E.* to *S. W.*,  $30^{\circ}$  high; and, shortly after, three others, stretching from *E. S. E.* to *W. S. W.*, the loftiest of which reached nearly to the zenith."—Graah, p. 60.

N. B.—1. Luminous arch, *N. E.* to *S. W.*,  $30^{\circ}$  high.

2. Three others, from *E. S. E.* to *W. S. W.*

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**At Sea.**—Lat.  $60^{\circ}$  N. Long.  $56^{\circ}$  W. October 6, 1818. ROBERTSON.

"Strong gales and squally, with snow and sleet. Observed the whole sky suddenly illuminated, which lasted five or six minutes. *This might be aurora in the zenith.* Wind *N. N. W.*, moderating towards noon."—1 John Ross (Robertson), App., cxvii.

N. B.—1. Whole sky suddenly illuminated.

2. *This might be aurora in the zenith.*

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**Kikkertak (Greenland).**—Lat.  $60^{\circ} 4'$  N. Long.  $43^{\circ} 2'$  W. April 12, 1829. GRAAH.

"In the evening of the 12th, some unusually brilliant coruscations of the Aurora Borealis were seen in the *E.* and *N. E.* They seemed to proceed from out of a thick bank of fog, about  $6^{\circ}$  or  $8^{\circ}$  above the horizon; and, after passing the zenith, appeared to be transformed into light clouds, for such were seen to flit past the moon in the southwesterly region of the heavens, while the northern was without a cloud.

They had no sensible effect on the magnetic needle."—Graah, p. 63.

N. B.—1. Brilliant coruscations in the *E.* and *N. E.*; seemed to proceed from a thick bank of fog.

2. After passing zenith, appeared to be transformed into light clouds.

3. No sensible effect on the magnetic needle.

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**Davis's Strait.**—Lat.  $60^{\circ} 10'$  N. Long.  $49^{\circ} 40'$  W. August 2, 1852. INGLESFIELD.

"A good deal of ice encountered off Capes Farewell and Desolation. Aurora in yellow and reddish coruscations on the western sky, extending near the zenith."—Inglesfield, p. 201.

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**At Sea.**—Lat.  $60^{\circ} 30'$  N.  $25^{\circ}$  W. Friday, October 13, 1820. PARRY.

"At seven p. m. on the 13th, the wind being squally from the *N. N. W.*, the Aurora Borealis began to display itself in a bright luminous patch in the *northeast*, resembling, as usual, the light of the moon behind a dark cloud.

From this point, faint and narrow coruscations shot upwards, passing a little to the northwestward of the zenith, and appearing to come down to the *W.* by *S.*

The blue sky between these streams of light looked at first like so many dark streaks or clouds, until the eye had become accustomed to it, and the clearness of the stars in them explained the deception.

In half an hour after, a bright arch,  $34^{\circ}$  high in the centre, and about  $2^{\circ}$  in breadth, extended from the luminous patch in the N. E. over to the W. S. W., so that the magnetic meridian would nearly bisect it. This part of the phenomenon remained about an hour, and then became faint; but the Aurora continued to give considerable light, as usual, during the rest of the night."—1 Parry, 307.

N. B.—1. At 7 p. m., a bright luminous patch in the N. E.

2. From this point, faint coruscations, passing a little to the N. of zenith, appeared to come down to the W. by S.

3. Half an hour after, a bright arch,  $34^{\circ}$  high in the centre, from N. E. over to W. S. W.

4. This remained almost an hour.

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**At Sea.**—Lat.  $61^{\circ}$  N. Long.  $25^{\circ}$  W. October 17, 1818. ROBERTSON.

"At eight p. m., observed the Aurora to begin in two concentric arches, the greatest arch from true east to west, passing through the zenith; the smaller arch south of the large one, at an altitude of  $45^{\circ}$ , shooting fine rays from all parts of the arches, but most brilliant from the western part. At half-past eight, these arches disappeared, and another most brilliant one was seen north of the zenith, the centre passing through the pole star, the extremities touching the eastern and western horizons, emitting fine rays having all the prismatic colors. This arch was soon broken, and the Aurora flitted about in beautiful coruscations in the northwestern part of the heavens, shifting round to the southward. The moon shone unclouded at the time, and the Aurora was sometimes seen passing her, eclipsing her in splendor.

At 9h. 30m. p. m., the Aurora disappeared, the weather moderate at the time, with some light fleecy clouds in the sky, which had a dark appearance when passing under the Aurora."—1 John Ross (Robertson), App., cxii.

N. B.—1. At 8 p. m., two concentric arches, from true E. to W., passing through the zenith.

2. At half-past 8, an arch N. of the zenith, the centre passing through the pole star; extremes touching E. and W. horizons.

3. Shifted round to the S.

4. Eclipsed the moon in splendor.

5. At 9h. 30m., disappeared.

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**At Sea.**—Lat.  $61^{\circ} 4'$  N. Long.  $49^{\circ} 50'$  W. August 4, 1852. INGLESFIELD.

"An Aurora Borealis was observed at midnight of the 4th, which illumined the whole of the southern sky with its variegated coruscations of brilliant light.

During the following day, we stood in to within eight miles of the shore, and it was supposed that we were off Omenarsuk."—Inglesfield, p. 13.

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**Moose-Deer Island.**—Lat.  $61^{\circ} 18' 8''$  N. Long.  $113^{\circ} 51' 35''$  W. 1822. FRANKLIN.

"Observations were made on the Aurora Borealis, in 1822, at Moose-Deer Island, lat.  $61^{\circ} 18' 8''$  N., long.  $113^{\circ} 51' 35''$  W., variation  $25^{\circ} 40' 47''$  E. Being unwilling, however, to swell the Appendix more than necessary, I shall not insert the tables, but merely remark, that—

Although the Aurora was frequently seen there, the coruscations were seldom either brilliant or of the variable kind. They caused but little alteration in the position of the needle, the greatest deviation observed being  $18'$ , and did not furnish grounds for any additional inferences to those which were drawn from the observations on the Aurora made at Fort Enterprise.

The display of light was generally confined to the *northern part of the sky*, between the true N. E. and S. W. points, usually at a low altitude; and the Aurora was observed extending to the *southward on four occasions only*. This, as well as the circumstance of the magnetic needle being but slightly affected by the presence of the Aurora during the winter at that place, appears to me to be deserving of notice, as affording an indication that *the seat of the phenomenon lies more to the northward*; and were I to venture an opinion as to its probable situation, I should say between the latitudes  $64^{\circ}$  and  $65^{\circ}$  N., or about the position of Fort Enterprise [lat.  $64^{\circ} 28' 24''$  N.,  $113^{\circ} 6'$  W.], because the coruscations were *as often seen there* in the southern as in the northern parts of the sky, and I should consider that latitude the most favorable in this part of the globe for making good observations on this interesting phenomenon."—1 Franklin, 553.

N. B.—1. Had but little effect on the needle.

2. Generally confined to the northern part of the sky, between the true N. E. and S. W. points.

3. Extended to the *southward on four occasions only*.

4. *Seat of the phenomenon* more to the northward.

5. Its situation probably between  $64^{\circ}$  and  $65^{\circ}$ .

6. At Fort Enterprise, coruscations seen as often in the south as the north parts of the sky.

7. That latitude most favorable for observations on the aurora.

**Davis's Strait.**—Lat.  $61^{\circ} 37'$  N. Long.  $52^{\circ}$  W. August 26, 1851. Dr. SUTHERLAND.

"In the evening the wind veered round to N., and freshened up from almost a perfect calm to a smart breeze. The spars of the 'Sophia' again began to feel it, as she scudded before it at the rate of five or six miles an hour.

At midnight, the whole sky was one living fire of Aurora Borealis. It far exceeded anything that we had seen in much higher latitudes during winter. The surface of the sea was sometimes illuminated so much, that had there been objects on the horizon at a distance of several miles, they would have been plainly visible."—Dr. Sutherland, II, 346.

**Davis's Strait.**—Lat.  $61^{\circ} 58'$  N. Long.  $54^{\circ} 40'$  W. August 25, 1851. Dr. SUTHERLAND.

"The temperature of the water was increasing almost hourly as we came down the Strait, and now it was up so high as  $47^{\circ}$ , while that of the air was only  $48^{\circ}$ . In the evening, there was much rain, and the sky was densely overcast.

There were all the indications of a southwesterly storm; but towards midnight they all disappeared, the blue sky opened out, and a most brilliant Aurora Borealis danced from the horizon to the zenith.

It was really pleasant to behold the broad gleaming bands folding like curtains of the richest and finest woven silken fabric. The color varied every moment from red to white, and from yellow to a slight tinge of green, verging into purple, which became lost in the red.

From the sudden appearance of this beautiful phenomenon, we hardly expected fine weather or a favorable wind, more especially as the barometer was too high for westerly winds."—Dr. Sutherland, II, 345.

**Faroe Islands.**—Lat.  $62^{\circ}$  N. TREVELYAN.

"Mr. Trevelyan observed, that the Aurora Borealis in Faroe and Shetland was often seen very low, not more than *forty or fifty feet* above the level of the sea; and he learned that in both countries *it is frequently heard*.

In Faroe, Mr. Trevelyan met one person who stated that, when the color of the Aurora Borealis is dark red, and extends from west to east with a violent motion, he had experienced a smell similar to that which is perceived when an electric machine is in action."—Am. Journ. Sci., VIII, 392; from Edinb. Phil. Journ., Vol. VII.

**Hudson's Bay.**—Lat.  $62^{\circ} 18' N.$  Long.  $87^{\circ} 12' 12'' W.$  September 18, 1824. LYON.

"Running till 10 p. m., we lay to for the night, as I had reason to suppose we were to the southward of Cape Southampton, and was more particularly confirmed in this opinion from the compasses having all again become restless.

This agitation having frequently been observed on other nights, between the hours of nine and eleven, had always been the cause of great anxiety to me, while endeavoring to steer a course after dark, unless the moon or stars were clearly visible; and it is well worthy of consideration whether this wildness of motion in the compasses is at all caused by the *absence* of the sun, or is in any way occasioned by the *presence* of the Aurora, which phenomenon was rarely seen earlier than 9 p. m., and the time when it was most vivid was generally at about 10. At this hour, on one occasion, Mr. Kendall observed, that during the prevalence of an unusually brilliant Aurora, the larboard binnacle compass would remain stationary at no particular point, while the starboard one, by a bearing of the pole star, had lessened its accustomed error two points.

By a bearing of the sun, on the following morning, it was found to have resumed its original position."—Lyon, pp. 118–19.

"At 10 p. m., I hove to, in consequence of the compasses becoming greatly agitated. This had frequently been observed on other nights, between the hours of nine and eleven, and had always been the cause of great anxiety to me while endeavoring to steer a course after dark.

It is well worthy of consideration, whether this agitation of the compasses is at all to be attributed to the *absence* of the sun, or is in any way occasioned by the *presence* of the aurora, which phenomenon was rarely seen earlier than 9 p. m.; and its greatest brilliancy was generally at about 10, although the sun had then been set some hours.

On one occasion, during the prevalence of an unusually brilliant aurora, at 10 p. m., Mr. Kendall observed that the larboard binnacle compass would not remain steady at any point, while the starboard one, by a bearing of the pole star, had decreased its accustomed error two points; but on the following morning, by a bearing of the sun, it was found to have resumed them.

N. B.—Up to this period, the error on this bearing had been eight points E."—Lyon, p. 167.

N. B.—Agitation of the compasses.

**At Sea.**—Lat.  $62^{\circ} 30' N.$  Long.  $63^{\circ} W.$  October 1, 1818. ROBERTSON.

"At eight in the evening the Aurora was seen in the true S. S. W. to S. S. E. At nine, the luminous appearance spread from S. W., round by the S. E. quarter, to N. E., in an arched form; the centre of the arch  $18^{\circ}$  high, the luminous part of arch  $8^{\circ}$  broad. There was a very dark appearance under the arch, through which the stars appeared with the same *glimmering* light that they shone with through the luminous parts. Small bundles of sharp pointed rays were shot perpendicular from all parts of the arch to the altitude of  $40^{\circ}$ . About ten the arch shifted more to the westward, and soon disappeared; fresh breezes from W. S. W."—1 John Ross (Robertson), App., cxxi.

N. B.—1. At 8 p. m., seen in true S. S. W. to S. S. E.

2. At 9 p. m., from S. W. by S. E. to N. E., in an arch.

3. Dark appearance under the arch.

4. At 10 p. m., arch shifted more to W., and soon disappeared.

**Near Rankin's Inlet.**—Lat.  $62^{\circ} 35' 47'' N.$  August 22, 1847. RAE.

"The Aurora was very bright last night. It appeared first to the S. S. E., moved rapidly northward, spreading all over the sky, and finally disappeared in the north.

This agrees with what Wrangel asserts, 'that the Aurora is affected by the wind in the same way as clouds are.'"—Rae, p. 188.



Hudson's Bay.—Lat.  $62^{\circ} 45' 44''$  N. Long.  $72^{\circ} 24'$  W. September 29, 1824. LYON.

"At noon we obtained observations, and in the evening made the coast, which we neared sufficiently before dark to discern to be the North Bluff, from whence at 8 p. m. we took a departure and steered southeast.

Along the shore, a great number of very large bergs were observed, apparently aground, as if driven to the northern land by the recent southerly winds.

We sailed past several during the night, which was exceedingly bright and fine, the stars shining with uncommon brilliancy, and the Aurora being unusually splendid."—Lyon (*Voyage*), p. 134.

N. B.—Aurora unusually splendid.

Fort Reliance.—Lat.  $62^{\circ} 46' 29''$  N. Long.  $109^{\circ} 00' 38''$  W. 1833–34, 1834–35. BACK.

"The observations on this phenomenon [the Aurora Borealis] were made, without interruption, during six months in the years 1833–34, and five months in the years 1834–35; but, as their entire insertion would occupy too much space here, I have selected chiefly the instances possessing the greatest interest from the effect produced by them on the needle, and from the brilliancy and eccentric motions of the coruscations.

That the needle was constantly affected by the appearance of the Aurora, seems evident from the facts thus stated; and, on one occasion, indeed, this effect exceeded eight degrees. I abstain, however, from drawing any inferences on this subject, and merely note down carefully, and with as much precision as possible, the whole of the phenomena.

Brilliant and active coruscations of the Aurora Borealis, when seen through a *hazy atmosphere*, and exhibiting the prismatic colors, almost invariably affected the needle. On the contrary, a very bright Aurora, though attended by motion, and even tinged with a dullish red or yellow, in a *clear blue sky*, seldom produced any sensible change, beyond, at the most, a tremulous motion.

A *dense haze or fog*, in conjunction with an active Aurora, seemed uniformly favorable to the disturbance of the needle; and a low temperature was favorable to brilliant and active coruscations. On no occasion, during two winters, was any *sound* heard to accompany the motions.

The aurora was frequently seen at twilight, and as often to the eastward as to the westward. *Clouds*, also, were often perceived in the daytime, in form and disposition very much resembling the Aurora."—Back, p. 595.

N. B.—1. Needle constantly affected by appearance of the Aurora.

2. Aurora frequently seen at twilight; as often to the eastward as westward.

3. Clouds often seen in daytime in form of Aurora.

Fort Reliance.—Lat.  $62^{\circ} 46' 29''$  N. Long.  $109^{\circ} 00' 38''$  W. October 28, 1833. BACK.

"At 5h. 30m. p. m., while occupied in taking the transit of a star, I perceived the coruscations streaming from behind a detached and oblong dark *cloud* in a vertical position at *E. by S.* [magnetic bearing]. They issued along an undulating arch  $38^{\circ}$  high, and spread themselves laterally in beams north and south. Another arch, brighter and narrower than the former, suddenly emerged from *W. by N.*, and passed between a nearly horizontal black cloud and the stars, which were then not visible through the Aurora. I immediately looked at the needle, and found it slightly agitated, but not vibrating; on returning, I was surprised to see the *dark horizontal cloud* to the westward not in the same shape as before. It had now taken a balloon form, and was evidently fast spreading towards the zenith. On looking to the eastward, I perceived that a *dark cloud* there also was rapidly altering its appearance.

So unusual a sight induced me to call my companions, Messrs. King and McLeod, and we saw the dark broad mass from the westward gradually expand itself, so as to meet the other, which was

likewise rising, at or near the zenith. The effect of the junction was a dark gray arch, extending from *E. by S. to W. by N.* across the zenith, and completely obscuring the stars, though at each side of the arch they were particularly clear and twinkling.

In the mean time, the Aurora assumed every variety of form; such as undulating and fringed arches,  $30^{\circ}$  to  $50^{\circ}$  high and more or less broad, with flashes and beams at right angles to them. The cloudy arch, too, was illuminated at and around its N. W. edges near the horizon, while rays and beams played round its eastern extremity. In a few seconds, the part of this nearest the horizon assumed a zigzag form, like forked lightning; and immediately the western extremity sympathized, undergoing momentary transitions which defy description. Such convulsions at the extremes soon affected the centre of the arch, which, becoming gradually fainter and fainter, at last vanished entirely, leaving the stars to shine forth in all their brilliance. The detached masses yet remained, though under various forms, and the Aurora nimbly played round and through them, especially the eastern one, until not the slightest vestige of them remained."—*Ibid.*, p. 200.

N. B.—1. At  $5\frac{1}{2}$  p. m., coruscations from a dark cloud, *E. by S.*

2. Stars not visible through the Aurora.

3. Needle slightly agitated.

4. Dark clouds—one *E.*, one *W.*

5. Meet at or near the zenith.

6. Form an arch from *E. by S. to W. by N.*

**Fort Reliance.**—Lat.  $62^{\circ} 45' 29''$  N. Long.  $169^{\circ} 00' 38''$  W. 1833-34. King.

"The Aurora Borealis, as soon as evening sets in, overspreads the ethereal space, as if intended by Providence to cheer the hours of darkness by its beautiful and varied coruscations. For about two hours after midnight, it was invariably observed by us to be most brilliant and active; passing from east to west, or *vice versa*, and *northerly*; sometimes appearing in the form of a splendid arch fitting across the heavens with inconceivable velocity, and resembling the spiral motions of a serpent. Then, suddenly disappearing, the veil of night would be at once diffused around; when, as quick as the flash of a star, a thousand dancing lights would again be seen playing mysteriously through the sky, assuming a variety of forms and diversity of motion, of which it is too difficult for an inanimate description to convey any idea.

It seldom appeared *southerly*, as if there was something in that part of the heavens which it dare not approach; but, commencing in the *eastern* or *southeastern* horizon—in which particular it coincides with the remarks of Parry and Crantz—would shoot across the zenith to the west, and descend in a variety of forms to the *northern* part of the earth, covering the whole of *that* portion of the concave with a brilliant light, while the opposite quarter of the hemisphere was enveloped in darkness.

Notwithstanding the Aurora is most frequent in the severest weather during a calm, yet I have seen equally vivid coruscations when the wind was blowing a stiff breeze; and although directly opposed to its motions, far from being in any way affected, it continued uninterruptedly on in its accustomed eccentricity. At times there would appear two currents in active motion from opposite points, approaching the zenith, where they formed a corona, presenting the appearance of so many snakes twisting with amazing swiftness; while at the same time a fringed, undulating arch, composed of numberless bright rays, would be seen fitting with inconceivable velocity from the horizon towards the zenith. Among them might be frequently observed streams of light perpendicular to the horizon, collected together, and moving with even greater velocity than the rest; which from their peculiar appearance have acquired the name of 'merry dancers.' The appearance of the Aurora is not confined to an unclouded sky; it was frequently observed by us in active motion when the heavens were partially obscured by a hazy atmosphere, and occasionally perceived emerging from behind a *black cloud*.

Capell Brooke observed this peculiarity at Hammerfest; and we had an opportunity of witnessing

the same strange phenomenon at Fort Reliance in November, 1883; at which time there were *two dark clouds* in opposite directions, and the coruscations brilliantly streaming in a variety of fantastic figures from behind them. The *clouds* in detached masses remained for some time assuming various forms, while the Aurora nimbly played round and through them until not the slightest vestige of their presence remained. We had also frequent opportunities of observing the appearances described by Parry, of long horizontal separations of the Aurora, resembling so many dark parallel streaks lying over it; which was evidently the dark indigo sky only, as the stars were plainly visible.

I have often observed a *gray haze*, effectually obscuring the sky, suddenly give way to a mass of light that illumined the whole face of the heavens, as if the atmosphere had instantaneously taken fire, leaving the sky, after it vanished, of a dark blue color, and studded with twinkling stars; while, on the contrary, the same *gray mist* has been noticed to take place on the subsidence of the Aurora, which was especially the case on the 4th of April, 1884.

There cannot be a doubt but that this meteor, from the intensity of its light, *dims* the stars; and from the following fact it is equally certain, that it *obscures the sky also in the form of white clouds during the day*, when its luminous appearance is eclipsed by the brightness of the sun.

A mass of *white cloud* was observed at 10 a. m. of the 28th of October, precisely similar in shape to an Aurora of the previous evening, and situated in the same place, at which time the sun was shining brightly. Captain Back having placed himself in the shade of a fir-tree, imagined that he saw a faint filmy arch of pale white issuing from it; and after watching more attentively, a pale yellow arch was seen shooting from the mass of cloud to the westward, and extending *southerly to S. E. by S.* at an angle of 80°. Afterwards several detached radial clouds became visible in the same point, which he more than once thought differed much in brightness.

*Clouds* were often observed by us in the daytime, in form and disposition very similar to the Aurora, especially on the 25th of last December [1883], when an arch of streaky and filmy clouds exactly resembling its coruscations extended from east to west across the zenith. Captain Parry was also 'struck with the general resemblance to the form of the Aurora assumed by the clouds, in the polar regions, at particular seasons.'

It has always been an interesting question with those who attempt to ascribe this beautiful phenomenon to electrical causes, whether the Aurora be attended with any *sound or noise*; and although many accurate observers have paid particular attention to this subject in various parts of the northern hemisphere, yet the point is far from being settled."—King, II, 90-95.

"On no occasion, during two winters, was any *sound* heard to accompany the motions of the Aurora by either Captain Back or myself. Once or twice I thought a sound was audible, but afterwards ascertained it to be the hissing noise produced by the sudden condensation of my breath into icy particles; and Captain Back several times positively declared he heard a whizzing noise during the rapidity of the motion, until he convinced himself it was the faint murmuring only of Anderson's Fall that had deceived him.

That a *change of color is perceptible in the Aurora*, is admitted by almost every author who has described its appearance. I believe it, however, to be of *rare occurrences*; for, during two winters of five months each, notwithstanding scarcely a night passed away without our observing this beautiful phenomenon, Captain Back and I only witnessed it vary from the flame or straw color eight times; five of which it appeared of a red, and the remaining three respectively of an indigo, lake, and orange color. In about the same lapse of time also it was noticed by Parry to vary three times only, of which it appeared twice of a lilac, and once of a green tint.

Whether the magnetic needle be affected by the appearance of the Aurora or not, still remains in doubt. There are different opinions upon the subject, and the observations taken by Captain Back and myself have not yet been reduced by the Professor who has undertaken to work them." —King, II, 96.

"In my humble opinion, *there are not sufficient facts yet collected to justify us in coming to any conclusions*, either as to the effect of the Aurora on the magnetic needle, or as to the most favorable situation for solving that problem.

According to Captain Back, who witnessed the Aurora at Forts Franklin and Enterprise, that meteor was not only more brilliant, but the streams of light more rapid, at Fort Reliance than

he had observed it at either of the former places; from which circumstance it might be inferred that the 62d parallel of latitude is even more favorable for the appearance of this phenomenon than the 65th. If, as has been stated, 'a low temperature is favorable to brilliant and active coruscations' of the Aurora, it is to the eastern extremity of Great Slave Lake that observers should direct their course to further this very interesting inquiry, as in that situation a more intense cold was experienced by ten degrees than had ever before been registered."—King, II, 98.

**Fort Reliance.**—Lat. 62° 46' 29" N. Long. 109° 00' 38" W. Winters of 1833-34 and 1834-35. KING.

"It fell to my share, during the two winters the expedition remained at Fort Reliance, to register the position of the needle one thousand and fifty times; but, as the subject will shortly be brought before the Royal Society, I shall offer only a few remarks.

I have sometimes observed the *needle quite stationary*, when the whole concave has been illumined with brilliant and active coruscations; and at other times witnessed it *moving horizontally* several degrees, without the least appearance of an Aurora, although, from the deep indigo color of the sky, it must have been seen had it been present. The same anomaly was remarked in a hazy atmosphere.

During the prevalence of counter currents, the needle was observed to dip, by estimation, at least ten minutes. On one occasion, however, the same action was apparently caused by applying the finger to the front glass of the frame containing the needle."—King, II, 101.

*Thermometer at Fort Reliance, January, 1834.*

| Day.       | Highest. | Lowest. | Day.       | Highest. | Lowest. |
|------------|----------|---------|------------|----------|---------|
| 11 . . . . | —32.00   | —47.00  | 17 . . . . | —45.00   | —70.00  |
| 12 . . . . | —41.00   | —56.25  | 18 . . . . | —38.00   | —45.00  |
| 13 . . . . | —50.00   | —59.50  | 19 . . . . | —35.00   | —54.00  |
| 14 . . . . | —47.00   | —59.00  | 20 . . . . | —22.00   | —50.00  |
| 15 . . . . | —44.25   | —52.00  | 21 . . . . | —36.00   | —49.75  |
| 16 . . . . | —52.50   | —68.00  | 22 . . . . | —25.00   | —48.00  |

Back, p. 568.

**Hudson's Bay (Rowe's Welcome).**—Lat. 63° 15' 44" N. Long. 89° 3' 30" W. September 5, 1824. LYON.

"In the evening, a bright arch rose in the northwest, and we quickly found that the gale had shifted with increased violence to that quarter. By night, not a cloud was to be seen, and there was every indication of a decided northwest gale."—Lyon (*Voyage*), p. 85.

N. B.—Bright arch in northwest.

**Southern Greenland.**—Winter of 1828-29. GRAAH.

"The northern lights (Aurora Borealis), a remarkable and beautiful phenomenon of which the inhabitants of the greater part of Europe can form no adequate conception, are in Greenland and Iceland a thing of every day occurrence, and serve materially to indemnify the Polar regions for the want of solar light experienced by them, in consequence of the long absence of the sun below their horizon.

It may be said to be of two kinds; the one appearing uniformly between the magnetic E. S. E. and S. W., or, W. S. W., in the form of a luminous arch, shining with a steady and more or less vivid light, its highest being, in the magnetic South, from 10° to 20° above the horizon,

and its legs seeming to rise out of the ocean. From this arch usually diverge rays towards the zenith, or a point in its vicinity. This description of Northern Light is colorless; and I think I have observed that it usually precedes, but still oftener follows after, some great change of temperature, especially from thaw to frost.

The other sort of Northern Light, which, still more than the former, seems to stand in connection with barometrical changes, flits from place to place in the semblance either of light luminous clouds agitated by the wind, and through which the light appears to diffuse itself with a sort of undulating motion, or of flaming rays, flashing, like rockets, across the firmament, most commonly upwards in the direction of the zenith, or, finally, like a serpentine or zigzag belt of vivid, undulating light, frequently colored, which at one moment is extinguished, and the next relit. The most beautiful of this class of phenomena, meanwhile, is the *Corona*, a luminous ring near the zenith, of from  $2^{\circ}$  to  $3^{\circ}$  in diameter, with rays diverging in every direction, like prolonged radii, from its centre. This highly interesting phenomenon seldom lasts longer than a few seconds, at the expiration of which an explosion, as it seems, takes place, scattering the luminous matter in every direction, and extinguishing it. The centre of the Corona I found to be invariably situated to the east of the meridian, at an elevation of from  $81\frac{1}{2}^{\circ}$  to  $82\frac{1}{2}^{\circ}$  above the horizon.

When the Aurora displays itself in all its splendor, its light is brighter than that of the full moon. It has been asserted, that this phenomenon is sometimes accompanied by a low, hissing noise. I myself, in fact, have often heard the sound, but am satisfied it has nothing to do with the Aurora, but proceeds partly from the ice, partly from the wind sweeping over the snow and ling-clad hills.

Whenever a more than usually vivid Aurora displayed itself, I made a point of taking measures to observe its effect on a magnet suspended by a silken fibre, but never detected any agitation or alteration in the direction of the latter, that could be attributed to this cause; though, I must add, that in making some like experiments, in the years 1823-24, at the Colony of Good Hope, situated in lat.  $69^{\circ} 14'$ , I did think that some such effect was perceptible.

That the substance-matter of the Aurora Borealis is liable to being acted on by the winds prevailing in different atmospheric strata seems evident, from the phenomenon itself, and as the changes of the weather depend again, in some degree, upon the winds, it is probable that a connection exists between them and the phenomenon of the Aurora. Many have hence inferred, that the appearance of the latter may safely be regarded as a prognostic of the former. This opinion, however, is, as far as I am aware, by no means well founded; and, in fact, all that may be securely relied on, with reference to this subject, is what follows:—

1. When the Aurora Borealis is vivid, and displays a variety of colors, boisterous or bad weather may be expected, and the wind may be looked for from that quarter where the Aurora has disappeared, or been extinguished.
2. When, after a long absence, an Aurora Borealis appears between S. W. and S. E. in the form of an arch, from  $10^{\circ}$  to  $20^{\circ}$  high, and glowing with a steady light, it is a prognostic of approaching frost.

The Greenlanders have a singular superstition connected with the phenomenon of the Aurora Borealis. They conceive it to be the spirits of the dead, playing at ball with the head of a walrus, and fancy that it draws nearer to them when they whistle,—a superstition at all events not more absurd than the idea long, and, indeed, still, prevalent in some parts of Europe, of its being ominous of war, pestilence, or famine.”—Grash, p. 52.

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**Beresov (Russia).—**Lat.  $64^{\circ}$  N. Long.  $65^{\circ}$  W. December 1, 1828. **ERMAN.**

“In order to determine the magnetic declination, I observed, about eight o'clock in the evening, the passage of the pole-star through the transit instrument. A few minutes after the observation was concluded, the clouds, which had hitherto obscured the lower part of the northern sky, disappeared, and we saw in their stead, a brilliant Auroral light.

Towards the horizon there was still some darkness, but above that there was bright light, which

rose highest at a point about  $27^{\circ}$  west of the astronomical,  $88^{\circ}$  west of the magnetical, north; the greatest elevation being about  $6^{\circ}$  above the horizon; and from that point an irregular arch of light extended downwards on both sides of the horizon. Extremely vivid bands of light, from half to three quarters of a degree in breadth, shot up frequently from different points of the arch. I could not perceive, however, that these radiations converged towards the zenith: on the contrary, those from the eastern side of the arch seemed decidedly to tend towards points east of the zenith; those from the western side, in like manner, to lean westwards, just as if they had all diverged from a point below the horizon and within the arch.

These phenomena continued, without any change of character, the whole night, till near sunrise, when the sky became clouded. In every part of the fixed arch, the light was in unceasingly tremulous motion; its brightness increased from time to time, and at those moments the radiated pillars of light also rose higher and brighter than usual. The color of the light was yellow-red, and underwent but little change. About twenty-five minutes past ten, the apparent width of the region of the heavens filled with light was measured, and was ascertained to lie within the vertical circles of N.  $15^{\circ}$  E., and N.  $80^{\circ}$  W.

\* \* \* \* \*

The fact that, in the present instance, neither the middle of the coruscating area, nor the point of the heavens from which proceeded the attraction for the south end of the needle, lay in the vertical plane of the magnetic meridian; but that while the polar light inclined to the west of that plane, the attracting point was distant about  $25^{\circ}.3$  from it towards the east, acquires importance from the unanimous and distinct assurance of the people of Beresov, that they are accustomed here to distinguish between two kinds of Polar Light. The one, like that seen to-day, which appears on the western side of the sky, is always fainter and lower than that which shows itself east of the meridian. The latter, which is sometimes observable for months together throughout the night, begins regularly about the time of the greatest cold, and is often so elevated and so bright, as to frighten the animals in the sledges.

December 2.—The people of Beresov all maintained that the Polar Light of yesterday announced the return of the regular cold, and this prediction was confirmed to-day in a remarkable manner."  
—Erman, I, 351–353.

**Good Hope (Greenland).—**Lat.  $64^{\circ} 10'$  N. Long.  $51^{\circ} 42'$  W. August 1, 1761—August 21, 1765. CRANTZ.

"And even if the moon does not shine in the winter, the northern lights, with their sportive streams of variegated colors, often supply its place still better. I will not enter into the illustration of the origin of this wonderful phenomenon, but only observe so much, that neither I nor those that have lived many years in this country, have ever seen the true Aurora Borealis, or Northern Lights, make their appearance in the north or northwest (except a faint blue glance over the horizon, which might arise from the reflection of the sun), but they have always sprung up in the east and southeast; from whence they have often, if not always, extended over the whole horizon as far as the northwest; and sometimes they may be seen in all the four quarters of the sky at once. Consequently, they have a quite different situation to those that are observed in Norway, Lapland, Russia, and all the other countries of Europe."—Crantz, I, 48.

N. B.—1. Aurora never makes its appearance in N. or N. W.  
2. It always springs up in E. or S. E.

**Reykjavik (Iceland).—**Lat.  $64^{\circ} 10'$  N. Long.  $21^{\circ} 25'$  W. Winter of 1814–15. HENDERSON.

"The most striking aerial phenomenon exhibited by an Icelandic winter, is doubtless the Aurora Borealis, or northern lights, which are here seen in all their brilliancy and grandeur. I had an opportunity of contemplating them almost every clear night the whole winter, sometimes shooting across the hemisphere in a straight line, and presenting to the view, for a whole evening, one

vast steady stream of light; but more commonly they kept dancing and running about with amazing velocity, and a tremulous motion, exhibiting, as they advanced, some of the most beautiful curved appearances. On gaining one point of the hemisphere, they generally collected as if to muster their forces, and then began again to branch out into numerous ranks, which struck off to the greatest distances from each other as they passed the zenith, yet so as always to preserve the whole of the phenomenon in an oval shape; when they contracted nearly in the same way as they expanded; and, after uniting in a common point, they either returned in the course of a few minutes, or were lost in a stream of light, which grew fainter and fainter, the nearer it approached the opposite side of the heavens.

They were mostly of a dunnish yellow, yet often assuming mixtures of red and green. When they are particularly quick and vivid, a crackling noise is heard, resembling that which accompanies the escape of the sparks from an electric machine.

They almost always took their rise from the summit of Mount Esian, which is about due *northeast* from Reykiavik, and proceeded in a *southwest* direction. When visible the whole length of the hemisphere, they were uniformly *strongest* towards the north and northeast, and were always sure to be seen in that quarter, when they appeared nowhere else. Once or twice I observed them in the south, but they were very faint and stationary."—Henderson, p. 277.

- N. B.—1. Aurora always took its rise in N. E.  
 2. And proceeded in S. W. direction.  
 3. Always to be seen in N. or N. E. when they appeared nowhere else.  
 4. Once or twice observed it in S., but they were very faint and stationary.

#### Iceland.—1820-21. THIENEMANN.

"Dr. L. Thienemann, who spent the winters of 1820 and 1821 in Iceland, made numerous observations on the *Polar Lights*. He states the following as some of the general results of his observations:—

1. The Polar Lights are situated in the lightest and highest clouds of our atmosphere.
2. They are not confined to the winter season or to the night, but are present, in favorable circumstances, at all times, but are distinctly visible only during the absence of the solar rays.
3. The Polar Lights have no determinate connection with the earth.
4. He never heard any noise proceed from them.
5. Their common form, in Iceland, is the arched, and in a direction from *N. E. to W. S. W.*
6. Their motions are various, but always within the limits of the clouds containing them."—Am. Journ. Sci., X, 187.

#### North End of Hunter's Portage.—Lat. $64^{\circ} 6' 47''$ N. Long. $118^{\circ} 23' 9''$ W. August 14, 1820. FRANKLIN.

"At eight p. m., a faint *Aurora Borealis* appeared to the southward. The night was cold, the wind strong from N. W."—1 Franklin, 219.

- N. B.—1. Faint Aurora to the southward.  
 2. The night cold.  
 3. Wind from northwest.

#### Near Fort Enterprise.—Lat. $64^{\circ} 15' 17''$ N. Long. $118^{\circ} 2' 39''$ W. Aug. 18, 1820. FRANKLIN.

"At ten p. m., the *Aurora Borealis* appeared very brilliant in an arch across the zenith, from northwest to southeast, which afterwards gave place to a beautiful *corona borealis*."—1 Franklin, 221.

- N. B.—1. At ten p. m., Aurora very brilliant in an arch across the zenith, from N. W. to S. E.  
 2. Gave place to a beautiful *corona borealis*.

**Rowe's Welcome.**—Lat.  $64^{\circ} 15' 27''$  N. Long.  $87^{\circ} 43' 46''$  W. September 9, 1824. LYON.

"Rain fell heavily with the gale, and our prospects were most unpromising, when, at ten p. m., a low red line was observed to *the westward*.

It slowly arose as an arch, and the whole of the black clouds began to recede from our heads. A blue and transparent sky in the west, soon discovered a few stars shining, and, in half an hour, the gloom which had shadowed us fell like a dark curtain to the eastward. As it sank, the full moon burst from behind it with the greatest brilliancy; and, in less than an hour from the first welcome appearance of the fiery streak on the horizon, not an angry cloud was to be seen.

A magnificent Aurora, composed of all the prismatic colors, flashed wildly and beautifully for a short period, and, *as we expected*, a heavy northwest gale succeeded to that from the southward."—Lyon (Voyage), p. 91.

N. B.—1. At ten p. m., a low red line to the W.

2. It slowly arose as an arch.

3. All the clouds went to eastward.

4. In an hour from the appearance of the fiery streak, not a cloud to be seen.

5. Magnificent Aurora composed of all the prismatic colors.

6. And, as we expected, a heavy N. W. gale succeeded to that from S.

**Fort Enterprise.**—Lat.  $64^{\circ} 28' 24''$  N. Long.  $118^{\circ} 6'$  W. December, 1820. FRANKLIN.

"The Aurora appeared with more or less brilliancy on twenty-eight nights of this month, and we were also gratified by the resplendent beauty of the moon, which, for many days together, performed its circle round the heavens, shining with undiminished lustre, and scarcely disappearing below the horizon during the twenty-four hours."—1 Franklin, 257.

N. B.—Aurora appeared with more or less brilliancy twenty-eight nights of the month.

**Fort Enterprise.**—Lat.  $64^{\circ} 28' 24''$  N. Long.  $118^{\circ} 6'$  W. January—May, 1821. FRANKLIN.

"*General Remarks.*—So few observations of the Aurora Borealis in high northern latitudes have been recorded, that I trust a minute account of the various appearances it exhibits, will not be thought superfluous or uninteresting.

The remarks of the late Lieutenant Hood are copied verbatim from his journal. They speak sufficiently for themselves to render any eulogium of mine unnecessary.

To this excellent and lamented young officer, the merit is due of having been, I believe, the first who ascertained, by his observations at Basquian Hill (combined with those of Dr. Richardson at Cumberland House), that *the altitude of the Aurora upon these occasions was far inferior to that which had been assigned to it by any former observer.*

He also was the *first who satisfactorily proved*, by his observations at Cumberland House, *the important fact of the action of the Aurora upon the compass needle.*

By his ingenious electrometer, invented at Fort Enterprise, he seems also to have *proved the Aurora to be an electrical phenomenon*, or at least that it induces a certain unusual state of electricity in the atmosphere.

The observations of Dr. Richardson, independent of their merit in other respects, point peculiarly to the *Aurora being formed at no great elevation*, and that it is dependent upon certain other atmospheric phenomena, such as the formation of one or other of the various modifications of cirro stratus.

With respect to my own observations, they were principally directed to the effects of the Aurora upon the magnetic needle, and the connection of the amount, &c., of this effect with the position and appearance of the Aurora.



I have been anxious to confine myself to a mere detail of facts, without venturing upon any theory. My notes upon the appearances of the Aurora coincide with those of Dr. Richardson in proving that the phenomenon is frequently seated within the region of the clouds, and that it is dependent, in some degree, upon the cloudy state of the atmosphere.

The manner in which the needle was affected by the Aurora will need some description. The motion communicated to it was neither sudden nor vibratory. Sometimes it was simultaneous with the formation of arches, prolongation of beams, or certain other changes of form, or of activity of the Aurora; but generally the effect of these phenomena upon the needle was not visible immediately, but in about half an hour, or an hour, the needle had attained its maximum of deviation. Its return to its former position was very gradual, seldom regaining it before the following morning, and frequently not until the afternoon, unless it was expedited by another arch of the Aurora operating in a direction different from the former one.

The bearings of the terminations of the arches are to be taken with considerable allowance. They were estimated by the position of the Aurora, with respect to the sides of the house, the angles of which had been previously determined. The bearings given in the whole of my observations refer to the magnetic meridian, and are reckoned from the magnetic North, towards the East, round the whole circle, which it is conceived will afford a means of more readily computing the horizontal extent of the arches.

It is to be noticed, that the bearings given by Dr. Richardson and Lieutenant Hood are true, and not magnetic."—1 Franklin, 589.

- N. B.—1. Altitude of Aurora far inferior to that assigned to it by former observers.  
 2. Action of the Aurora on the compass needle.  
 3. Aurora an electrical phenomenon.  
 4. Aurora formed at no great elevation; dependent on formation of cirro stratus.

**Fort Enterprise.**—Lat.  $64^{\circ} 28' 24''$  N. Long.  $118^{\circ} 6'$  W. January—May, 1821. FRANKLIN.

*“Observations on the Aurora at Fort Enterprise, extracted from the Journal of Captain Franklin.—*

The forms of the Aurora Borealis, during the winter, have been so various and fleeting, that it is impossible to comprehend them in a general outline; and the inferences I have drawn on a subject, respecting which I had not prepared my mind by previous study, are offered with diffidence.”—1 Franklin, 549.

“Before adverting to the effect of the Aurora on the needle, I must premise that the arch-like appearance of the Aurora, noted in the daily remarks, did not always resemble a portion of a great circle; but, on the contrary, frequently crossed the zenith, without originating and terminating in opposite points of the horizon; and although the general arrangement of the parts gave the idea of an arch, yet this arch was frequently broken, and its portions disconnected.

The color of these arches varied from gray to a lively yellow, and in clear weather the light emitted was generally observed to be more brilliant and dense than when an opposite state of the atmosphere existed.

The horizontal bands or masses of light mentioned in the notes, appeared indiscriminately in every quarter of the sky, and at different elevations; they more frequently originated or terminated in the magnetic east or west, but not invariably so; and we have seen them on more than one occasion begin and end in the magnetic meridian. Their light varied much in density, and was generally of a yellowish hue.

The arches and horizontal bands of Aurora occasionally separated into parts or beams, which had a quick lateral motion. At such times the colors were generally most vivid, and now and then prismatic. The extremities of these beams did not appear to point uniformly to any particular part of the sky, but to depend entirely upon the direction of the arch which they composed.

The term ‘beam,’ used in the notes, does not always allude to the appearances just mentioned, but is also applied to the commencement of an arch when it appears in an uniform stream of light,

issuing from the horizon, and before it has attained an altitude sufficient to give it an arched form.

The arches of the Aurora most commonly traversed the sky nearly at right angles to the magnetic meridian, but the deviations from this direction, as has been already stated, were not rare; and I am inclined to consider that these different positions of the Aurora have considerable influence upon the direction of the needle."—1 Franklin, 550.

"In one instance only, a complete arch was formed in the magnetic meridian; in another, the beam shot up from the magnetic north to the zenith; and, in both these cases, the needle moved towards the west.

The needle was most disturbed on February 18, p. m., and at a time when the Aurora was distinctly seen passing between a stratum of clouds and the earth, or at least illuminating the face of the clouds opposed to the observer.

This and several other appearances, recorded in the accompanying notes, induced me to infer that the distance of the Aurora from the earth varied on different nights, and produced a proportionate effect on the needle.

When the light shone through a dense hazy atmosphere, when there was a halo round the moon, or when a small snow was falling, the disturbance was generally considerable; and on certain hazy, cloudy nights, the needle frequently deviated in a considerable degree, although the Aurora was not visible at the time.

Our observations do not enable us to decide whether this ought to be attributed to an Aurora concealed by a cloud or haze, or entirely to the state of the atmosphere. Similar deviations have been observed in the daytime, both in a clear and cloudy state of the sky, but more frequently in the latter case.

Upon one occasion, the Aurora was seen immediately after sunset, whilst the bright daylight was remaining.

A circumstance to which I attach some importance must not be omitted. Clouds have been sometimes observed during the day to assume the forms of the Aurora, and I am inclined to connect with the appearance of these clouds the deviation of the needle, which was occasionally remarked at such times.

An Aurora sometimes approached the zenith without producing any change in the position of the needle, contrary to the general effect, whilst at other times a considerable alteration took place, although the beams or arches did not come near the zenith. The Aurora was frequently seen without producing any perceptible effect on the needle. At such times its appearance was that of an arch or an horizontal stream of dense yellowish light, with little or no internal motion."—1 Franklin, 551.

"I have not heard the noise ascribed to the Aurora, but the uniform testimony of the natives and of the residents in this country induced me to believe that it is occasionally audible. The circumstance, however, must be of rare occurrence, as is evidenced by our having witnessed the Aurora upwards of two hundred times without being able to attest the fact. I was almost inclined, last year, to suppose that unusual agitations of the Aurora were followed by storms of wind; but the more extended opportunities I enjoyed of observing it in 1821, at Fort Enterprise, have convinced me that no such inference ought to have been drawn."—1 Franklin, 552.

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Fort Enterprise.—Lat.  $64^{\circ} 28' 24''$  N. Long.  $118^{\circ} 6'$  W. January—May, 1821. FRANKLIN.

"Notices of the Appearances of the Aurora at Fort Enterprise, extracted from Captain Franklin's Journal.—The following appearances of the Aurora Borealis were noted at the times when the position of the horizontal needle was observed. They have been described as they appeared to the eye, without any regard to perspective. The bearings of the terminations of the arches or beams, are reckoned from the magnetic north towards the east and south, round the whole circle.

Jan. 12, 1821, midnight. A very faint arch in the zenith, lying  $324^{\circ}$  and  $144^{\circ}$ . The sky cloudless. 14th. At 7h. 30m. p. m., the Aurora first appeared in a patch bearing  $279^{\circ}$ , from which darted a

slender faint beam, that passed about  $4^{\circ}$  east of the zenith and then instantly disappeared. A horizontal stream extended from  $279^{\circ}$  to  $54^{\circ}$ , elevated about  $20^{\circ}$ . At 8h. 20m., a faint coronation across the zenith. At 11h. 20m., a brilliant, irregular, wreathed arch across the zenith, from  $279^{\circ}$  to  $99^{\circ}$ , the interior motion passing rapidly from the horizon at the former bearing to the latter. Soon afterwards, this arch twisted round, so that its extremities were directed to  $122^{\circ}$  and  $234^{\circ}$ ; the internal motion very rapid. At 11h. 30m., the coronation had removed from the zenith, and appeared in a line parallel to the horizon, extending from  $99^{\circ}$  to  $234^{\circ}$ . At midnight, horizontal streams from  $99^{\circ}$  to  $234^{\circ}$ , and from  $279^{\circ}$  to  $234^{\circ}$ ; but the latter had the greater elevation. The needle drawn considerably to the westward. Just as I had left the instrument, a flash darted from a beam  $118^{\circ}$  towards the zenith, and instantly a different Aurora appeared tinged with the prismatic colors, having an agitated circular motion. A few seconds afterwards, a beam flashed from  $279^{\circ}$ , and united with that which shot from bearing  $118^{\circ}$ ; and then a continuous though irregular arch was formed from the one horizon to the other, and the interior motion passed rapidly from both these extremities towards the zenith. As long as the arch continued in that direction, the needle pointed as at midnight; but in about two minutes, the arch descended towards the east, and then the needle gradually returned eastward to its zero, in which position it remained until the coronation had disappeared.

At 1h. a. m., Aurora visible in patches  $279^{\circ}$  and  $99^{\circ}$ , and a beam  $245^{\circ}$ ; the needle then stood at  $345^{\circ} 16'$ , having moved eastward  $24'$  since midnight. At 9h. p. m., January 15th, the needle had attained the usual position at that hour; the Aurora then appeared in the zenith. At midnight, a waving irregular arch continued across the zenith from  $279^{\circ}$  to  $99^{\circ}$ , and a rapid interior motion passed from the former to the latter direction. Motion of the needle westward.

16th. At 12h. 30m., faint streams from  $99^{\circ}$ , inclining to the westward.

20th. At 11h., an arch crossed the zenith; and at midnight, a patch appeared  $54^{\circ}$  lying parallel to the horizon.

21st. An arch from  $99^{\circ}$  to  $212^{\circ}$ , elevation about  $10^{\circ}$ . At midnight, a broad patch in the zenith. Slender beams rose from  $234^{\circ}$  and  $31^{\circ}$ , which were prolonged to the zenith, and came almost in contact with this patch; at the same time, a low arch proceeded from  $279^{\circ}$  to  $54^{\circ}$ . Between nine and midnight, the needle moved westward 52 minutes.

22d. At 9h. p. m., an arched horizontal stream from  $110^{\circ}$  to  $54^{\circ}$ . At midnight no Aurora perceptible, yet the needle had changed its position.

23d. 9h. p. m. A brilliant arch across the zenith, from  $279^{\circ}$  to  $99^{\circ}$ , composed of slender beams lying parallel to each other. The motion passed from  $99^{\circ}$  to the zenith. This arch separated in the zenith. The westward part disappeared entirely, but a column of light remained at  $99^{\circ}$ . Motion of the needle westward. At 12h., thick hazy weather; no Aurora visible. Needle had moved eastward.

24th. 9h. p. m. Two low arches extending from  $99^{\circ}$  to  $178^{\circ}$ . At midnight, the coronations were generally diffused over the upper part of the sky; but the streams traversed the zenith in a different direction from the course they more frequently take, and their extremities were at  $54^{\circ}$  and  $234^{\circ}$ . The most conspicuous beam, rising  $245^{\circ}$ , proceeded to the zenith, and curled round so as to point towards  $335^{\circ}$ . The next in brilliancy came from bearing  $76^{\circ}$ , which also crossed the zenith, but did not unite with the other beam. There were two other streams of light running in the same direction. The needle had moved  $48'$  eastward since nine, and in a contrary way to the course it usually followed when vertical arches crossed the zenith at about  $279^{\circ}$  or  $234^{\circ}$ .

25th. 9h. p. m. A brilliant curve; terminations  $324^{\circ}$  and  $76^{\circ}$ , elevation about  $50^{\circ}$ . Several beams jutted from this curve, pointing towards the horizon. At 11h., a beam rose at  $279^{\circ}$ , passed over the zenith to  $99^{\circ}$ , then ran horizontally, and formed an irregular band from  $99^{\circ}$  to  $171^{\circ}$ . The portion of light at  $99^{\circ}$  was stratified by intervening layers of clouds.

27th. A beam elevated about  $13^{\circ}$  at midnight whilst snow was falling.

28th. 9h. p. m. An arch from  $99^{\circ}$  to  $249^{\circ}$ . At 11h., the coronation generally diffused over the south and eastern parts of the sky, which seemed to have proceeded from a slender beam bearing  $99^{\circ}$ , from whence a flash darted to the zenith, which instantly dilated into a broad mass of light.

- At midnight, an elevated arch and a low convex stream extended from  $99^{\circ}$  to  $200^{\circ}$ . A beam at  $94^{\circ}$  pointing towards the zenith. Needle stationary.
- 29th. At 11 $\frac{1}{2}$ h., a broad arch across the zenith from  $99^{\circ}$  to  $257^{\circ}$ , and a horizontal fringed belt from  $99^{\circ}$  towards the east, at a low elevation. At midnight, the S. E. portion of the sky was occupied by a dense mass of light, which resembled an open fan branching upwards. A stream shot from the eastern part of it, and proceeded in an arch to  $290^{\circ}$ , the centre being elevated  $70^{\circ}$ . Several patches in the zenith parallel to this arch. In two minutes afterwards the fan disappeared, and a brilliant curved stream darted forth at  $110^{\circ}$ , and shot to the westward; its centre bore  $138^{\circ}$ , elevated  $25^{\circ}$ .
- 30th. An arch across the zenith from  $302^{\circ}$  to  $121^{\circ}$ , but the extremities did not approach either horizon by  $20^{\circ}$ .
- 31st. At 9h. p. m., two horizontal bands of light extended from  $99^{\circ}$  to  $212^{\circ}$ , the lowest being elevated  $8^{\circ}$ . The S. E. end was wavy, and it appeared as if several beams had been twisted together. There was also a beam at  $302^{\circ}$ , directed towards the zenith. At midnight, an elliptical arch proceeded from  $99^{\circ}$  to  $279^{\circ}$ , by the south and westward, at a low elevation. Several streams issued from this band between  $279^{\circ}$  and  $245^{\circ}$ , each pointing towards the zenith. This arch separated after a few minutes, and then two parallel arches were displayed having the same direction. Slight motion of the needle eastward.
- February 1st. At 11h., an arch across the zenith from  $279^{\circ}$  to  $99^{\circ}$ , for a considerable time stationary. This arch descended to the westward a few minutes before midnight, and when at an elevation of  $30^{\circ}$  it disappeared. The stars were perfectly visible through the column of light. Needle stationary.
- 2d. At midnight, a stream spread from  $110^{\circ}$  to  $267^{\circ}$ , ascending gradually from the horizon to an elevation of  $80^{\circ}$ . The stars appeared through the light with undiminished brilliancy.
- 3d. At 9h. p. m., Aurora commenced by a brilliant arch across the zenith, from  $279^{\circ}$  to  $99^{\circ}$ , extending to each horizon, which remained stationary and motionless for several minutes. By midnight, the coruscation was generally diffused over the sky. A broad brilliant band, elevated  $10^{\circ}$ , extended from  $99^{\circ}$  to  $200^{\circ}$  through an arch of about  $279^{\circ}$ . An illuminated curve branched from the latter termination, which pointed to  $245^{\circ}$ , and from this bearing a beam shot across the zenith towards the opposite direction; but it had not proceeded above five degrees eastward of the zenith, when it suddenly turned to the north and assumed a scroll shape. The needle immediately moved eastward, which is the same direction it had been observed to follow on January 14th, when the streams of light appeared in nearly a similar position in the zenith, namely, lying east and west true, or about  $54^{\circ}$  and  $234^{\circ}$  magnetic bearings, but in a contrary direction to that in which it had been observed to move when the arches crossed the zenith, having their extremities at  $279^{\circ}$  and  $99^{\circ}$ , or at  $324^{\circ}$  and  $144^{\circ}$ . This coruscation remained for several minutes, when the vertical arch disappeared, and a band was presented lying parallel to the horizon from  $212^{\circ}$  to  $279^{\circ}$ . Shortly afterwards, a similar band of light proceeded from  $76^{\circ}$  to  $324^{\circ}$ , and the horizon was almost encompassed with a brilliant zone; color pale yellow. No motion of the Aurora perceptible.
- 4th. At midnight, a faint slender beam arose at  $290^{\circ}$ , and flashed to the zenith; at the same instant, another proceeded from  $99^{\circ}$  to an elevation of  $50^{\circ}$ . A broad low stream of light from  $76^{\circ}$  to  $346^{\circ}$ , and a faint belt from  $189^{\circ}$  to  $234^{\circ}$ . No change was perceived in the needle.
- 5th. The atmosphere very dense and hazy. The needle had been disturbed in the night, and showed this morning a considerable change of position. At midnight, Aurora gleamed through the haze in two arches, the extremities  $54^{\circ}$  and  $234^{\circ}$ , and they passed the zenith. One of them turned towards the north, and the other towards the south. The needle moved to the eastward, as on February 3d and January 14th, when the Aurora appeared in a similar position.
- 6th. At midnight, Aurora was perceived across the zenith,  $279^{\circ}$  and  $99^{\circ}$ , gleaming through a very dense atmosphere, and when snow was falling. Two stars only were visible. Motion of the needle since 9h. p. m.,  $28'$  westward.
- 8th. A faint stream at  $99^{\circ}$  towards the zenith.
- 9th. At 9h. p. m., a beam at  $290^{\circ}$ . At 11h., a broad arch traversed the zenith from  $290^{\circ}$  to  $110^{\circ}$ ,

- which remained until 45 minutes after midnight, and then disappeared at bearing  $99^{\circ}$ . Motion of the needle westward.
- 10th. At midnight, an arch resembling a horse-shoe, the extremities of which bore  $99^{\circ}$  and  $76^{\circ}$ . From each of these points streams were projected across the zenith towards  $290^{\circ}$ , but they did not reach the opposite horizon. They were of a faint grayish-yellow color. The stars shone brilliantly through the columns of light. Moon very bright. The needle was not the least affected. I have observed that the needle is usually most disturbed by the appearance of the Aurora in dense hazy weather.
- 11th. At 8h. p. m., a cloud extended in an arch from  $99^{\circ}$  to  $279^{\circ}$ , elevated  $30^{\circ}$ , which bore a strong resemblance to the Aurora, particularly at the end at  $279^{\circ}$ , from whence some beams were projected towards the zenith. The needle was not affected.
- 12th. At 8h. 30m. p. m., faint curved streams in the zenith. At 9h., an arch from  $99^{\circ}$  to  $279^{\circ}$ , exactly similar in shape to the cloud seen yesterday. The color resembled the halo round the moon. The needle was not affected. At 11h. 40m., the coruscations occupied a considerable portion of the northern part of the sky, lying in parallel arches from  $76^{\circ}$  to  $279^{\circ}$ . The centre one was brilliant, and the motion, resembling a volume of smoke, passed from the former bearing towards the latter. Some arches appeared in the zenith lying  $65^{\circ}$  and  $245^{\circ}$ , and flashes darted with instantaneous motion from these towards the point to which their extremities were directed. The needle betrayed a slight motion eastward. At 12h., a broad band of light from  $302^{\circ}$  to  $54^{\circ}$ , elevated  $20^{\circ}$ .
- 13th. The atmosphere was so dense this night that the stars were completely obscured, and the edges of the moon could only be faintly traced through the haze. At 9h. p. m., there was not any appearance of the Aurora, and the needle rested at  $348^{\circ} 30'$ , its usual position at this hour when undisturbed by the Aurora. At 11h. 30m., faint streams of light gleamed through a large portion of the heavens, both in the zenith and near the horizon, and immediately afterwards brilliant coruscations burst forth of the most agitated kind. At 11h. 40m., a horizontal stream extended from  $279^{\circ}$  to  $81^{\circ}$ , and the anterior motion, similar to rolling smoke, passed from the first point to the latter. The needle was now drawn  $3^{\circ} 30'$  to the eastward, or as far as  $345^{\circ} 00'$ . At 11h. 50m., there appeared another stream of irregular shape, which proceeded from  $279^{\circ}$  in a line nearly parallel to the horizon, until it curled round at  $9^{\circ}$ , or near the direction of the magnetic meridian. The interior motion flashed along this stream with the utmost rapidity. The needle moved now to  $343^{\circ} 50'$ , or  $4^{\circ} 40'$  eastward of its first position; and, during the appearance of this coruscation, I perceived the needle to oscillate between  $348^{\circ} 50'$  and  $344^{\circ} 40'$ ; and it may be remarked this was the only occasion on which a vibratory motion was observed. On the disappearance of this display, brilliant semicircular curves were presented in the same quarter, ornamented with all the prismatic colors. At 11h. 55m., the needle had receded westward as far as  $347^{\circ} 00'$ . The important fact of the existence of the Aurora at a less elevation than that of dense clouds, was evinced on two or three occasions this night, and particularly at 11h. 50m., when a brilliant mass of light, variegated with the prismatic colors, passed between an uniform, steady, dense cloud and the earth; and, in its progress, completely concealed that portion of the cloud which the stream of light covered until the coruscation had passed over it, when the cloud appeared as before.
- The observations of this evening seem to corroborate the remark which I had previously made, that the direction in which the needle moves appears to depend on the position in which streams of Aurora are placed, and the quantity of the effect upon its proximity to, or distance from, the earth. When the extremities of arches lay near the bearings of  $234^{\circ}$  and  $54^{\circ}$ , the needle moved eastward; and when near the bearings  $324^{\circ}$  and  $144^{\circ}$ , or  $279^{\circ}$  and  $99^{\circ}$ , the motion of the needle was westward. Both of these facts were shown to-night. At the first display, when the extremities of the arches pointed near  $234^{\circ}$  and  $54^{\circ}$ , and the interior motion followed the same direction, the needle moved eastward as far as  $345^{\circ} 00'$ ; but after midnight, the coruscations ceased to appear in that direction, and, at 12h. 10m., were presented in three arches, traversing the zenith, whose extremities pointed  $121^{\circ}$  and  $302^{\circ}$ ; the needle then receded towards the west, and rested at  $349^{\circ} 30'$ , having varied its position  $5^{\circ} 40'$  in the course of twenty minutes.

## RECORD OF AURORAL PHENOMENA.

14th. At 11h. 30m., a faint low band proceeded from  $110^{\circ}$  to  $178^{\circ}$ , elevated  $8^{\circ}$ , and another at a higher elevation from  $121^{\circ}$  to  $212^{\circ}$ . These streams crossed each other in the bearing  $155^{\circ}$ ; and it may be remarked that this is the only occasion on which I have seen the streams to cross each other. They separated before midnight; the eastern one ascended some degrees higher, but the other remained in the same state. Cloudless sky.

15th. At 9h. p. m., Aurora crossed the zenith from  $257^{\circ}$  to  $76^{\circ}$ . None visible at midnight, yet the needle had moved forty minutes westward.

18th. At 9h. p. m., Aurora gleamed through the horizon in a continuous arch from  $279^{\circ}$  to  $99^{\circ}$ .

19th. At 8h. p. m., Aurora appeared to the eastward in five arches, having the same extremities at  $88^{\circ}$  and  $279^{\circ}$ . The upper arch crossed the zenith, and the others were elevated between  $15^{\circ}$  and  $20^{\circ}$ . At midnight, two concentric arches appeared through the haze, lying across the zenith; their extremities bore  $65^{\circ}$  and  $245^{\circ}$ . The needle then pointed to  $848^{\circ} 5'$ , having moved  $40^{\circ}$  eastward. At 12h. 25m., a broad and more brilliant arch crossed the zenith, from  $188^{\circ}$  to  $315^{\circ}$ ; the needle then moved westward  $1^{\circ} 5'$ , to  $849^{\circ} 10'$ . This change is a further confirmation of the observations on February 18th.

20th. At 9h. p. m., beams of light issued at  $99^{\circ}$  and pointed towards the zenith. At 10h. 30m., a brilliant arch from  $99^{\circ}$  to  $279^{\circ}$ , elevated  $80^{\circ}$ , a small arch in the zenith, and several beams at  $279^{\circ}$ . At midnight, several beams arose parallel to each other between  $335^{\circ}$  and  $349^{\circ}$ . In a few seconds, flashes were emitted from them, which first darted to the zenith, and then, twisting round, shot towards a stream that had proceeded at the same instant from  $312^{\circ}$ , which they joined. The coruscation now resembled an irregular horse-shoe, composed of many slender beams of brilliant light. This display soon passed off to the eastward, having descended to the horizon before it disappeared. The needle was not in any way disturbed after nine, from which circumstance I am induced to suppose that the Aurora was very distant. We seldom witnessed a greater variety of arches, beams, and flashes than were displayed this night, both in the horizon and zenith. If these coruscations had passed as near to the earth as they appear to have done at other times, some effect, I conceive, would have been produced on the needle. The sky was cloudless.

On the following morning, it was perceived that the needle had receded two degrees eastward, and it did not regain its usual position before 4h. p. m. At 8h. p. m., a horizontal band of faint light extended from  $88^{\circ}$  to  $245^{\circ}$ , elevated  $7^{\circ}$ , which remained almost stationary until midnight, at which hour two brilliant arches appeared, whose united extremities bore  $279^{\circ}$  and  $76^{\circ}$ ; and a faint broad arch traversed the zenith from  $279^{\circ}$  to  $88^{\circ}$ . Needle moved eastward. Shortly afterwards, the horizon was encircled with an illuminated zone, and the northern part of the sky covered with Aurora.

22d. At 9h. p. m., a continuous arch across the zenith from  $279^{\circ}$  to  $99^{\circ}$ ; the color pale yellow. Needle moved westward.

23d. At 9h. p. m., a low band, parallel to the horizon, extending from  $302^{\circ}$  to  $346^{\circ}$ , patches at  $76^{\circ}$ , and some faint streams in the zenith pointing to  $234^{\circ}$  and  $54^{\circ}$ . The needle had moved eastward. At 11h. 15m., a broad brilliant arch extended from  $29^{\circ}$  to  $99^{\circ}$  across the zenith, reaching to each horizon. The needle had, since 9h., receded  $24'$  westward. At midnight, two arches appeared; one from  $54^{\circ}$  to  $324^{\circ}$ , elevated  $50^{\circ}$ , the other from  $234^{\circ}$  to  $144^{\circ}$ , elevated  $12^{\circ}$ .

24th. At 9h. p. m., a continuous arch, through which the stars were distinctly visible, passed from  $99^{\circ}$  to  $279^{\circ}$  across the zenith, and a beam appeared parallel to this, proceeding from  $99^{\circ}$ , which terminated in the zenith. At midnight, two belts of brilliant light extended from  $99^{\circ}$ —one by the south and west, the other by the north—which encircled the horizon at an elevation of  $20^{\circ}$ , except between the points  $324^{\circ}$  and  $322^{\circ}$ . No perceptible disturbance of the needle.

26th. At midnight, a brilliant arch issued from  $318^{\circ}$  and reached to  $99^{\circ}$ , the centre being elevated  $20^{\circ}$ . At the latter point, the coruscation curved upwards, and was then prolonged across the zenith to  $300^{\circ}$ . The stars shone through this stream with undiminished brilliancy. The needle moved a few minutes westward.

27th. At 9h. p. m., two arches crossed the zenith from  $76^{\circ}$  to  $279^{\circ}$ , very broad and brilliant; the stars were distinctly visible through them. At midnight, the Aurora was diffused over a great

portion of the sky. Three arches appeared parallel to each other in the zenith, whose extremities pointed to  $54^{\circ}$  and  $234^{\circ}$ , and a horizontal stream about  $30^{\circ}$  high, reaching from  $302^{\circ}$  to  $31^{\circ}$ , along which the interior motion was extremely rapid. Soon afterwards, some dense clouds overspread the sky, but the Aurora gleamed through. The needle moved near two degrees eastward after nine. It kept an easterly position until after 2h. p. m. on the next day, and then it receded  $40'$  in the course of an hour. The clouds were of a fleecy kind, which sailors denominate a mackerel sky. At midnight, an irregular band extended from  $88^{\circ}$  to  $200^{\circ}$ , at an elevation of  $15^{\circ}$ . A beam at  $324^{\circ}$  pointing towards the zenith.

March 1st. At 9h. p. m., an arch stretched from  $99^{\circ}$  to  $155^{\circ}$ . At 11 $\frac{1}{2}$ h., when the snow was falling heavily, and a dense atmosphere obscured the stars, the Aurora appeared in an arch across the zenith, having its extremities  $88^{\circ}$  and  $200^{\circ}$ , but did not extend to either horizon. This stream disappeared before midnight. The atmosphere was then more dense, and the snow descended in larger flakes. Between midnight and the following morning, the needle was drawn  $45'$  to the eastward, and it did not recover its usual position before 9h. p. m. on March 2d.

2d. At 8h. 30m. p. m., Aurora appeared in a broad arch from  $279^{\circ}$  to  $99^{\circ}$ , and continued without any alteration until nine, when the needle had moved 32 minutes westward. The breadth of the arch then increased considerably, and a dark cloud passing along its middle gave an appearance of two arches. At midnight, the cornucations occupied many parts of the sky. Two faint arches crossed the zenith from  $99^{\circ}$  to  $279^{\circ}$ . A more brilliant arch extended from  $76^{\circ}$  to  $290^{\circ}$ , at an elevation of  $60^{\circ}$ . Several patches between  $54^{\circ}$  and  $246^{\circ}$ , and a broad band from  $279^{\circ}$  to  $223^{\circ}$ . The needle did not evince any material change.

3d. At midnight, a slender beam at  $76^{\circ}$ , and a patch at  $279^{\circ}$ . Needle had moved 10 minutes westward since nine.

4th. At midnight, an arch across the zenith,  $54^{\circ}$  and  $234^{\circ}$ , in which the interior motion ran swiftly from the former to the latter bearing. A low band extended from  $279^{\circ}$  to  $246^{\circ}$ . Motion of the needle 10 minutes eastward since nine.

5th. A low stream from  $121^{\circ}$  to  $139^{\circ}$ , at an elevation of  $10^{\circ}$ . No change in the position of the needle.

6th. The atmosphere very hazy, and snow fell. No Aurora visible, but the needle moved 30 minutes westward between nine and midnight.

8th. At 6h. 30m. p. m., Aurora appeared, whilst the western horizon was tinged with the rays of the recently-departed sun, in two beams from  $99^{\circ}$  extended to the zenith. At 9h. p. m., a brilliant stream from  $121^{\circ}$  to  $212^{\circ}$ , elevated  $10^{\circ}$ . A beam, having a wavy form, ascended from  $99^{\circ}$  to the zenith; its color a bright yellow; the stars were seen distinctly through it. No change in the needle. At midnight, Aurora was diffused over a great portion of the sky. A broad arch crossed the zenith, whose extremities were at  $88^{\circ}$  and  $200^{\circ}$ , but they did not reach either horizon. A band stretched from  $279^{\circ}$  to  $76^{\circ}$ , elevated  $12^{\circ}$ , from which three beams were prolonged nearly to the zenith, between  $302^{\circ}$  and  $225^{\circ}$ . Needle moved  $1^{\circ} 5'$  westward.

9th. At nine, Aurora brilliant and variable; the interior motion passed rapidly from  $224^{\circ}$  to  $54^{\circ}$ . An arch across the zenith, extremities  $279^{\circ}$  and  $99^{\circ}$ . A horizontal band from  $245^{\circ}$  to  $76^{\circ}$ . No change in the needle. At midnight, some patches bearing  $324^{\circ}$ . An arch was instantly projected from that, bearing across the zenith to  $144^{\circ}$ . This arch separated in the zenith, and both parts passed off against the wind to the westward. The needle moved 30 minutes westward between nine and 11h. 30m.

11th. At 9h. p. m., a waving arch passed from  $290^{\circ}$  to  $88^{\circ}$ , about  $2^{\circ}$  east of the zenith, and reached from one horizon to the other. An elliptical arch from  $313^{\circ}$  to  $76^{\circ}$ , elevated about  $50^{\circ}$ . At 11h., two waving streams stretched from  $279^{\circ}$  to  $43^{\circ}$ , and some beams shot from both these extremities towards the zenith, but more numerous from  $279^{\circ}$ . The needle had moved  $1^{\circ} 8'$  westward, between nine and eleven. Whilst I was looking at the instrument, a flash darted towards the zenith from a low beam bearing  $9^{\circ}$ , and the needle immediately moved  $8'$  westward; but the arch having in a few seconds passed over to the south, the needle returned eastward to its first position. At midnight, a beam arose at  $54^{\circ}$ , darted to the zenith, and then the upper extremity turned so as to point to  $144^{\circ}$ . Another beam darted from  $257^{\circ}$  and joined the former one. The arch thus formed descended gradually against the wind. There was only a slight

lateral motion perceptible while it remained across the zenith, but when it had sunk to about  $60^\circ$  from the horizon, an interior motion rushed from each of the extremities towards the middle, and, at the place of contact, the greatest commotion was excited, and the prismatic colors were exhibited. The motion of the needle 8 minutes eastward. This arch disappeared at an elevation of  $25^\circ$ . Between 11h. and midnight, sounds were repeatedly heard resembling the hissing of a musket-ball or the shaking of a thin pliant stick in the air, which were at first supposed to have been occasioned by the motion of the Aurora. Mr. Wentzel, however, who assured us that he had often heard the noise of the Aurora, said these sounds were very dissimilar to that which the Aurora makes, and that he supposed the noise to be occasioned by the cracking of the snow, in consequence of a great decrease in temperature immediately after the two preceding days of mild weather. I was of the same opinion, from the circumstance of a similar noise having been heard after midnight coming from the eastward, in which quarter there was not the least appearance of Aurora, and when only a faint motionless beam was visible to the eastward. This opinion was further confirmed on the following morning, when similar sounds were distinctly heard at the time the sun was shining bright and there was not any symptom of Aurora.

13th. At midnight, faint streams from  $88^\circ$ , directed towards the zenith. Some patches visible in other parts of the sky.

13th. At midnight, a beam shot from  $302^\circ$  across the zenith to  $88^\circ$ . Another extended to the zenith, whose lower extremity bore  $290^\circ$ . A horizontal band from  $234^\circ$  to  $257^\circ$ . The needle, since nine, moved  $1^\circ 25'$  westward.

14th. At 9h. p. m., a faint beam at  $99^\circ$  pointing towards the zenith. At midnight, a faint low stream from  $76^\circ$  to  $110^\circ$ . No change in the needle.

15th. At midnight, waving streams from  $110^\circ$  to  $144^\circ$ , and from  $189^\circ$  to  $212^\circ$ , elevated  $20^\circ$ . No change in the needle.

16th. At 3h. p. m., some clouds appeared about  $279^\circ$  which bore a strong resemblance to the Aurora, particularly one of the beams, which extended  $40^\circ$  towards the zenith. The needle moved  $18'$  westward between 3h. and 5h. p. m. At midnight, a faint stream of Aurora reached from  $65^\circ$  to  $279^\circ$ , elevation  $25^\circ$ . No change in the needle.

19th. At 9h. p. m., a faint arch from  $121^\circ$  to  $212^\circ$ , elevated  $25^\circ$ . At midnight, low streams from  $144^\circ$  to  $324^\circ$ , which nearly encircled the horizon. Seven beams were projected upwards from different parts of this zone. Their points did not meet in the zenith, but terminated about  $3^\circ$  short of that part. The whole appearance strongly resembled an artificial globe, the zone being the equator, and the beams the meridian lines. The needle moved  $25'$  eastward between nine and midnight, but I observed it to move gradually westward as these beams were disappearing. Immediately after they had ceased to be visible, an arch was exhibited crossing the zenith in the direction of the magnetic meridian. The needle still continued to recede westward, until it rested nearly in the position at which it was at 9h. p. m.

20th. At 9h., an arch from  $99^\circ$  to  $279^\circ$ . A beam at  $99^\circ$  pointing towards the zenith. A stream from  $257^\circ$  to  $290^\circ$ . At midnight, a low stream from  $302^\circ$  to  $54^\circ$ , along which the interior motion passed very rapidly. The needle moved  $1^\circ$  westward. The sky was overspread with fleecy clouds.

21st. At 11h. a. m., some clouds lying parallel to the horizon, between  $346^\circ$  and  $76^\circ$ , strongly resembled the Aurora. At 9h. p. m., Aurora in a bright arch from  $99^\circ$  to  $280^\circ$ , passing within  $8^\circ$  of the zenith. This descended to the eastward against the wind. At midnight, two beams darted from  $144^\circ$ ; one shot across the zenith to  $290^\circ$ , the end of the other curved round just beyond the zenith, and, in a few minutes, both of them rushed back to  $144^\circ$ , and then disappeared. A waving stream reached from  $279^\circ$  to  $99^\circ$ , elevated  $12^\circ$ ; several beams were projected upwards from this stream. A beam darted from  $54^\circ$  across the zenith, and, immediately after this flash, the lower extremity of the beam moved round to  $99^\circ$ , and an arch was formed from  $99^\circ$  to  $279^\circ$ . The needle moved nearly  $2^\circ$  westward, between nine and midnight. At 12h. 30m., Aurora generally diffused over the sky. A brilliant arch crossed the zenith from  $279^\circ$  to  $110^\circ$ . This soon afterwards separated, so as to form three arches parallel to each other. Some beams



- laid at right angles to this arch, which had come from the eastern horizon or bearing  $54^{\circ}$ . No motion in the needle perceptible.
- 22d. At 9h., Aurora in an arch from  $290^{\circ}$  to  $88^{\circ}$ ; a bright band from  $88^{\circ}$  to  $65^{\circ}$ . At midnight, the following appearances of the Aurora were visible through a very dense atmosphere. A beam at  $324^{\circ}$ , elevated  $15^{\circ}$ ; an arch from  $234^{\circ}$  to  $121^{\circ}$ , and some short beams at  $76^{\circ}$ .
- 23d. At 9h., two parallel arches from  $318^{\circ}$  to  $76^{\circ}$ , supported on buttresses at both extremities. The appearance resembled a bridge of light. At 11h. 30m., the northern and eastern parts of the sky were entirely free from Aurora. Some irregularly-curved streams extended from  $99^{\circ}$  to  $234^{\circ}$ , and dark clouds intervened between them. At midnight, three arches from  $110^{\circ}$  to  $234^{\circ}$ , the upper one most brilliant. No perceptible interior motion of the Aurora. The needle moved  $10^{\circ}$  westward after nine.
- 24th. At 9h. p. m., Aurora appeared through the clouds and snow, traversing the zenith in the direction of  $65^{\circ}$  and  $245^{\circ}$ . The needle moved eastward  $1^{\circ} 5'$ . At midnight, a beam from  $99^{\circ}$ , of slender breadth, when near the horizon, dilated considerably in its ascent, and at its termination in the zenith spread so as nearly to cover the upper part of the heavens. Another beam arose from the same point, curved several degrees to the westward, and then proceeded to the zenith. These beams quickly disappeared, but a low arch, extending from  $279^{\circ}$  to  $65^{\circ}$  remained stationary. The needle moved westward, between nine and midnight,  $1^{\circ} 22'$ .
- 25th. At 9h. p. m., faint beams at  $324^{\circ}$  and  $144^{\circ}$ . At midnight, a horizontal stream from  $138^{\circ}$  to  $228^{\circ}$ , some beams at  $324^{\circ}$ , and patches in several other parts; all very faint.
- 26th. At 9h. p. m., a faint Aurora at  $99^{\circ}$ . At midnight, a mass of dense light burst forth, bearing  $65^{\circ}$ , at an elevation of  $30^{\circ}$ , which presently curved round, and assumed the shape of a horse-shoe. At that instant, a beam flashed from  $324^{\circ}$  to the nearest part of the curve, and immediately an arch proceeded upwards, and passed about  $3^{\circ}$  eastward of the zenith. The needle moved eastward  $12'$ .
- 28th. At 8h. p. m., when daylight was perceptible to the westward, a stream of Aurora issued from a dark mass of cloud bearing  $110^{\circ}$ , and proceeded upwards in the direction of  $846^{\circ}$ ; but, when it reached the zenith, the upper part inclined to the westward, and an arch was formed from  $110^{\circ}$  to  $290^{\circ}$  reaching from one horizon to the other. Some smaller streams appeared about  $189^{\circ}$ , lying parallel to a range of clouds which resembled it in color, both being a steel-gray. The extremities of these streams pointed  $121^{\circ}$  and  $257^{\circ}$ . At 9h. p. m., clear weather. Three arches appeared; one from  $94^{\circ}$  to  $290^{\circ}$ , elevated  $80^{\circ}$ , the other from  $290^{\circ}$ , passing about  $2^{\circ}$  east of the zenith, and the third went parallel to this, and united in the same points in the horizon, but they were separated in the zenith by a stream of cloud. In two minutes afterwards, the first arch disappeared, and the two others, closing in the zenith, formed one broad stream, and passed off to the westward. Stars were faintly seen. At midnight, a very dense atmosphere obscured the sky; neither stars nor Aurora visible. The needle, however, moved  $85'$  westward between nine and midnight.
- 29th. A faint gleam of Aurora fringed the upper part of some dark clouds between  $138^{\circ}$  and  $155^{\circ}$ .
- 30th. At 9h., a broad arch across the zenith from  $88^{\circ}$  to  $290^{\circ}$ , and the interior motion was rapid. At midnight, an arch from  $110^{\circ}$  to  $257^{\circ}$ , elevated  $20^{\circ}$ . It separated in the zenith, and then the light passed instantaneously down to each horizon. Needle moved westward.
- April 1st. The changes in the position of the needle this morning deserve some notice. At 8h. a. m. it was nearly in the same position as at midnight; an hour afterwards it had moved  $12'$  eastward, and by eleven  $10'$  more. At 8h. a. m., there was a mackerel sky to the north, the strata of the clouds being vertical. Near the west horizon there was a layer of dense clouds, which soon spread over the whole sky. At 11h., these dark clouds gave place to a thin fleecy sky, and many blue portions were seen. The needle then returned towards the westward, and by four had reached within two minutes of the point at which it stood at 9h. a. m. At 9h. 30m. p. m., the Aurora appeared through a hazy atmosphere, in an arch from  $99^{\circ}$  to  $234^{\circ}$ .
- 5th. An arch passed from  $88^{\circ}$  to  $178^{\circ}$ , at a low elevation. At midnight, an arch, composed of several streams apparently blended together, issued from  $110^{\circ}$ , and passed about  $10^{\circ}$  west of the zenith to the horizon at  $279^{\circ}$ . This arch separated in the zenith, and then each part passed

- over to the horizon at  $279^{\circ}$ . A very slender faint arch remained from  $9^{\circ}$  to  $189^{\circ}$ . The needle moved a little westward.
- 6th. At 9h., masses of light of irregular breadth fringed the upper part of a range of clouds extending from  $99^{\circ}$  to  $212^{\circ}$ . At midnight, a waving low stream from  $99^{\circ}$  to  $212^{\circ}$ , of dense light, the motion rapid, going towards the latter bearing. Motion of the needle westward.
- 7th. At 9h. p. m., an arch stretching from  $279^{\circ}$  to  $110^{\circ}$ ; motion of the needle westward. At 10h. 30m., a very irregular arch from  $99^{\circ}$  to  $234^{\circ}$ . The interior motion darted rapidly in opposite directions, and the red, purple, and violet colors were exhibited. Numerous slender beams, in which there was a quick lateral motion, shot from this arch; some of them were projected to the zenith. The arch separated at  $121^{\circ}$ , and the western portion immediately rushed towards the north, preserving the same elevation. At this instant, the wind changed from the north to the opposite direction, south. At midnight, a horizontal band appeared from  $99^{\circ}$  to  $234^{\circ}$ , and several beams to the southward. The needle moved eastward  $37'$  between nine and midnight.
- 8th. At 11h. 10m. p. m., various streams appeared, stratifying a dense mass of clouds. In two parts of this coruscation, the motion darted from  $144^{\circ}$  and  $234^{\circ}$  towards the zenith; in another, from  $76^{\circ}$  to the horizon at  $144^{\circ}$ . The needle had moved westward  $2^{\circ} 19'$  since nine. At midnight, a beam rose at bearing  $65^{\circ}$ , and darted to an elevation of  $38^{\circ}$ . Nearly at the same instant, another beam issued from  $9^{\circ}$  and joined this, and then an arch was formed terminating in these bearings. Several other masses of light were seen to the eastward. The needle had moved eastward  $1^{\circ} 55'$  since the last observation. Heavy dark clouds spread over a large portion of the sky.
- 11th. At midnight, a faint gleam of Aurora appeared through a very dense atmosphere, and when there was a halo round the moon.
- 13th. Atmosphere hazy; no Aurora or stars were visible, yet there was a motion of the needle  $7^{\circ}$  to the westward between nine and midnight.
- 14th. A faint arch from  $313^{\circ}$  to  $133^{\circ}$  at midnight.
- 15th. At 9h., several brilliant beams bearing  $54^{\circ}$ , in which there was much lateral motion and a variety of colors. An arch crossed the zenith from  $313^{\circ}$  to  $133^{\circ}$ . Needle moved westward  $9'$ . At midnight, an arch across the zenith from  $290^{\circ}$  to  $110^{\circ}$ . Another from  $65^{\circ}$  to  $313^{\circ}$ , the motion passing rapidly from the latter to the former horizon. Needle moved a little more westward.
- 18th. At midnight, a faint patch bore  $144^{\circ}$ .
- 19th. At midnight, streams of a dense pale yellow light, at a low elevation, nearly parallel to the horizon, and extending from  $99^{\circ}$  to  $200^{\circ}$ . These were stationary for some hours; dark clouds lay between them.
- 20th. Whilst daylight remained, the Aurora was perceived fringing the upper part of a mass of dense cloud, in shape like the festoons of a curtain. It extended from  $99^{\circ}$  to  $200^{\circ}$ . At midnight, a waving arch of low elevation from  $76^{\circ}$  to  $212^{\circ}$ . Needle had moved  $45^{\circ}$  westward since nine.
- 21st. At 7h. p. m., some streams of cloud which resembled the Aurora in shape and color, crossed the zenith; but when the daylight disappeared, no Aurora was visible.
- 23d. At 10h. 30m. p. m., Aurora first appeared in an arch from  $279^{\circ}$  to  $189^{\circ}$ , elevation  $12^{\circ}$ . Needle moved westward  $1^{\circ} 11'$ .
- 27th. At midnight, aurora appeared through the haze in two low arches from  $99^{\circ}$  to  $189^{\circ}$ .
- 29th. Aurora beamed through the haze in low streams of faint yellow color.
- 30th. At 11h. 40m., some patches of Aurora at  $144^{\circ}$ , elevated  $20^{\circ}$ . No motion perceptible in the needle.
- May 1st. The coruscations were very agitated and brilliant between 11h. and midnight, but they did not produce any change in the needle.
- 3d. At midnight, Aurora proceeded from a mass of dense cloud bearing  $99^{\circ}$ ; passed near the zenith to  $257^{\circ}$ . The attenuated beams of which this arch was composed had a quick lateral motion. Little change in the needle. Daylight in the eastern part of the sky.
- 5th. A faint stream proceeded from  $144^{\circ}$  to an elevation of  $45^{\circ}$ . Needle moved westward.

I did not observe any Aurora after this day, but Mr. Hood saw it on the 6th, 10th, 11th, 12th, and 18th, after which date there was constant daylight, which prevented us from seeing it."—1 Franklin, 554-569.

**Fort Enterprise.**—Lat.  $64^{\circ} 28' 24''$  N. Long.  $113^{\circ} 6'$  W. January—May, 1829. FRANKLIN.

"The appearance of the Aurora, and the disturbance it occasioned on the motion of the needle at Fort Enterprise, was so frequent, that the mean monthly variation must have been deduced from but few observations if they had been rejected.

The circumstance of the mean variation being least at midnight there, and at Moose-Deer Island, was evidently caused by the frequent disturbance in the motion of the needle which the Aurora occasioned; for on those days when it was not visible, the mean diurnal variation followed the course Mr. Hood had observed it to do at Cumberland House, being most easterly at the time of the first observation in the morning, and least between three and four in the afternoon.

The change in the diurnal variation in these parts of North America seems to be governed by the same law as that in England, as the decrease in easterly variation between the morning and afternoon is in fact a motion of the needle to the westward."—1 Franklin, 629.

N. B.—1. Motion of the needle frequently disturbed by the appearance of the Aurora.

2. Mean variation being least at midnight, evidently caused by the frequent disturbance in the motion of the needle which the Aurora occasioned.

**Fort Enterprise.**—Lat.  $64^{\circ} 28' 24''$  N. Long.  $113^{\circ} 6'$  W. Winter 1820-21. HOOD.

"*Appearances of the Aurora at Fort Enterprise.* Extracted from the Journal of Lieutenant Hood, R. N.—January 10, 1821. At 8h. p. m., an arched Aurora N. N. W. to N. N. E. At 11h. p. m., a double arch, much broken but not bright, from N. W. to S. E.

11th. At midnight, faint Aurora from west to east.

14th. At midnight, five arches of Aurora from N. W. to S. E. A large Corona Borealis."—1 Franklin (Hood), 588.

**Fort Enterprise.**—Lat.  $64^{\circ} 28' 24''$  N. Long.  $113^{\circ} 6'$  W. 1820-21. HOOD.

"*On the Aurora Borealis at Fort Enterprise.* Extracted from the Journal of Lieutenant Robert Hood, R. N.—During the summer of 1820, the Aurora was only once visible before the month of August, when the nightly temperature of the air was generally below  $50^{\circ}$ . The late continuance of daylight, and the few opportunities which we had of making observations at the most favorable hours, render it possible that the Aurora may have sometimes appeared in this long interval without our knowledge. But those opportunities were sufficiently numerous to convince me that it is actually very seldom present in these regions during the summer.

The number of Auroræ visible in August, 1820, was ten; in September, six; in October, seven; in November, eight; in December, twenty; in January, 1821, seventeen; in February, twenty-two; in March, twenty-five; in April, eighteen; and in May the brightness of twilight prevented us from seeing more than nine.

The whole amount is more than double the number of our observations at Cumberland House.

It is worthy of remark, that the number of Auroræ in each month of both the winters, bears some proportion to the thermometrical range."—1 Franklin (Hood), 580.

N. B.—1. Number of appearances of Aurora at Fort Enterprise.

2. More than double the number of observations at Cumberland House.

"The shapes of the Aurora at its entry into the horizon and progress through the sky, may be reduced under two general descriptions.

In the first, I shall class those which are formed like rainbows or arches, in the earliest stage of their appearance.

They rise with their centres sometimes in the magnetic meridian, and sometimes several degrees to the eastward or westward of it.

The number visible at the same time seldom exceeds five, and is seldom limited to one. The altitude of the lowest, when first seen, is never less than  $4^{\circ}$ . As they advance towards the zenith, their centres (or the parts most elevated) preserve a course nearly in the magnetic meridian or parallel to it. But the eastern and western extremities vary their respective distances, and the arches become irregularly broad streams in the zenith, each dividing the sky into two unequal parts, but never crossing one another till they separate into parts.

Those arches which were bright at the horizon increase their brilliancy in the zenith, and discover the beams of which they are composed when the interior motion is rapid.

This interior motion is a sudden glow, not proceeding from any visible concentration of matter, but bursting out in several parts of the arch, as if an ignition of combustible matter had taken place, and spreading itself rapidly towards each extremity."—1 Franklin (Hood), 580.

N. B.—*Shapes of the Aurora at its entry into the horizon; First Class.*

1. Those which are formed like rainbows or arches.
2. Rise with their centres sometimes on magnetic meridian; sometimes E. or W. of it.
3. Number visible at same time seldom exceeds five; seldom limited to one.
4. Rise towards zenith, with their centres nearly in magnetic meridian.
5. But the E. and W. extremities vary their respective distances.
6. Arches bright at the horizon, increase in brilliancy in the zenith.

"The second general class of Auroræ are those which propagate themselves from different points of the compass, between north and west, towards the opposite points; sometimes, also, originating in the S. E. quarter, and extending themselves towards the N. W.

They may be subdivided, like the former, into the distant arches, which pass to the southward without much visible change in their appearance; and those which discover beams, and separate at intervals into wreaths, flashes, and irregular segments, exhibiting all the phenomena described above.

In explaining the mode by which the two general classes of Auroræ are conducted into the horizon, I shall call the motion of the arches (which is in a plane seldom deviating more than two points from the magnetic meridian) *the direct motion*, and that by which the Auroræ propagate themselves nearly at right angles to the magnetic meridian *the lateral motion*.

Let us suppose a mass of Aurora to be modelled at its birth in a *longitudinal form*, crossing the meridians at various angles, the whole to be impelled with a direct motion towards the magnetic south, but the parts having different velocities, and each extremity continually removing itself, by a lateral motion, from the centre, so as to *increase the length of the mass*.

If the centre enter the northern horizon, it will appear like an arch, the real extremities being invisible; and its direct motion will carry it to the southward in that form.

But if one extremity first enter the horizon, it will extend itself, by its lateral motion, to the opposite point, passing at the same time, by its direct motion, to the southward."—1 Franklin (Hood), 582.

N. B.—*Second General Class of Aurora.*

1. Those which propagate themselves from different points of the compass.
2. Direct motion.
3. Lateral motion.
4. Longitudinal form.

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Fort Enterprise.—Lat.  $64^{\circ} 28' 24''$  N. Long.  $113^{\circ} 6'$  W. March 8, 1821. Hood.

"On the 8th of March, 1821, at 5h. 30m. p. m., immediately after sunset, an arched Aurora was visible, extending from N. W. to S. E. by S. This was the earliest period of the day at which

we saw it; for although it might, from the shortness of the days in December and January, have been seen at 3h. p. m., if present, it seldom appeared before 7h. p. m., and was usually most brilliant at midnight.

On the 11th of February, the clouds formed a regular arch, extending N. N. W. to E., and the needle of a compass, fixed in the house for the purpose of making observations, receded 20' from the magnetic meridian to the westward. I saw these clouds disperse, and afterwards collect in a different form. The disturbance of the compass is another proof of the presence of the Aurora during the day; but, on the whole, there is reason to conclude that such is not often the case."—1 Franklin (Hood), 583.

- N. B.—1. Arch from N. W. to S. E. by E. (immediately after sunset), at 5h. 30m.  
 2. In January and December, it could have been seen at 3h. p. m.  
 3. Yet seldom appeared before 7h. p. m.  
 4. And was most brilliant at midnight.

**Fort Enterprise.**—Lat.  $64^{\circ} 28' 24''$  N. Long.  $118^{\circ} 6'$  W. March 13, 1821. Hood.

"On the 13th of November (1820), the Aurora was seen between the clouds and the earth, by Mr. Franklin and Dr. Richardson.

On the 18th of March (1821), I saw an Aurora, which was emanating in wreaths from the N. W., pass over the lower surface of a stratum of white clouds. The upper edge of the clouds was 80 feet distant from the lower, and its azimuth S.  $85^{\circ}$  W. The Aurora passed at the altitude of  $70^{\circ}$ , and, therefore, could not have been more than two miles from the earth, supposing that the elevation of the clouds was two and a half miles. The wind was west, and the temperature of the air  $36^{\circ}$ .

Another circumstance, which twice came under my observation, is too remarkable to be omitted. The Aurora was very brilliant near the zenith, the sky perfectly clear, and the wind moderate, when a discharge took place of small flakes of snow, which continued during several minutes. In both instances, showers of snow had fallen about half an hour before; but, at the precise period of these phenomena, no clouds were visible  $10^{\circ}$  above the horizon. To account for them on any known principles, we must wholly abandon Euler's theory of the zodiacal light and Dr. Halley's circulation of magnetic effluvia."—1 Franklin (Hood), 583.

N. B.—Aurora between the clouds and the earth.

**Fort Enterprise.**—Lat.  $64^{\circ} 28' 24''$  N. Long.  $118^{\circ} 6'$  W. April 27, 1821. Hood.

"On the 27th of April, 1821, at 10h. 30m. p. m., a single column of Aurora rose in the north, and traversed the zenith towards the south; another column appearing N. E. by E., and taking a parallel direction. The first was slightly agitated, and the beams momentarily visible. It passed to the western horizon in ten minutes, and was followed by the other, which became brighter as it approached the zenith.

I am now convinced they were borne away by the wind, because the columns preserved exactly their distance from each other during their evolution, and some detached wreaths, projected from them, retained the same relative situations of all their parts; which never happens when the Aurora is carried through the air by its own direct motion. The wind was E. by N., a strong gale, and the temperature of the air  $9^{\circ}$ .

It must be admitted that the influence of the wind upon the Aurora was never suspected until the 27th of April. However, there are several particulars connected with the subject, which may have prevented such an influence from manifesting itself on former occasions.

- 1st. When the convulsions were rapid and brilliant, they forced themselves against the wind, or in a contrary direction, without any perceptible difference of speed; from which circumstance

I was led to suppose that they were not in any degree affected by the wind, and did not afterwards pay sufficient attention to discover my error.

2d. The prevalent winds were from the eastward and westward; and the arches usually extending from N. W. to S. E., the influence of the wind might have been mistaken for their lateral motion.

3d. The northerly winds, acting from the same quarter as the direct motion, were confounded with it.

Lastly. The southerly winds, which were not common, always filled the atmosphere with clouds, so that the Aurora was not visible.

Perhaps, after all, the Aurora of the 27th of April was nearer to the earth than any other which we saw."—1 Franklin (Hood), 584.

N. B.—Aurora borne away by the wind.

**Fort Enterprise.**—Lat.  $64^{\circ} 28' 24''$  N. Long.  $113^{\circ} 6'$  W. March 11, 1821. HOOD.

"On the 11th of March, at ten p. m., a body of Aurora rose *N. N. W.*, and after a mass of it had passed to *E. by S.*, the remainder broke away in portions consisting each of several beams, which crossed about  $40^{\circ}$  of the sky with great rapidity.

We repeatedly heard a *hissing noise*, like that of a musket-bullet passing through the air, and which seemed to proceed from the Aurora; but Mr. Wentzell assured us that this noise was occasioned by severe cold succeeding mild weather, and acting upon the surface of the snow previously melted in the sun's rays. The temperature of the air was then  $-35^{\circ}$ , and on the two preceding days it had been above zero. The next morning it was  $-42^{\circ}$ , and we frequently heard a similar noise.

Mr. Hearne's description of the noise of the Aurora agrees exactly with Mr. Wentzel's, and with that of every other person who has heard it. It would be an absurd degree of skepticism to doubt the fact any longer, for our observations have rather increased than diminished the probability of it.

We were informed by the natives that the Aurora indicated, by peculiar appearances, the state of the atmosphere which was to follow on the ensuing day.

For instance, when it is bright and the motion rapid, it will be succeeded by a strong wind; but when attenuated and expanded over the sky, by mild and cloudy weather.

A careful examination of the meteorological journal does not furnish sufficient foundation for these conclusions. But, although the influence of the Aurora upon the weather has been deemed insignificant, it is by no means improbable that the latter considerably affects the former.

To suppose a luminous body, floating in the air and sometimes situated near the clouds, is within the bounds of the ordinary atmospherical changes, and may announce those changes by assuming a form which must be in some measure determined by the circumambient pressure, is not, I should think, inconsistent with any philosophical principles.

If we had not, unfortunately, lost the only instrument calculated for the purpose, we might at least have ascertained what relation the weight of the air bears to this interesting meteor."—1 Franklin (Hood), 585.

N. B.—1. Noise supposed to proceed from the Aurora.

2. Is occasioned by severe cold, succeeding mild weather, acting on the surface of the snow.

**Fort Enterprise.**—Lat.  $64^{\circ} 28' 24''$  N. Long.  $113^{\circ} 6'$  W. Winter of 1820-21. RICHARDSON.

"Remarks on the Aurora Borealis at Fort Enterprise. Extracted from Dr. Richardson's Journal.—

The account of the Aurora Borealis in the following pages is an exact transcript of notes taken at the moment of the appearance of the different phenomena.

To place a connected view of the appearances before the reader, the whole of the observations in the month of December, 1820, have been given, to which a few remarkable nights in the other months have been added.

The altitudes and dimensions of the different masses of light were ascertained merely by the eye, and, therefore, have no pretensions to accuracy; and it is only the *apparent* shapes that are described, the effect of perspective not being taken into account.

The bearings given of the Aurora are also to be taken with some latitude, but they are more likely to be generally correct than the altitudes, as they were ascertained by the different angles of our buildings; or, in some cases, when the masses of light were near the horizon, by their relations to distant trees and peaks of hills, whose bearings from the spot of observation were known.

To reduce the bearings given to magnetic bearings, the easterly mean variation of the compass at Fort Enterprise, amounting to  $86^{\circ} 20'$ , is to be applied.

The dip of the needle there was  $86^{\circ} 59'$ .

To show the condition of the atmosphere with regard to the transmission of sound, and its capacity for moisture, the state of a rapid about a quarter of a mile from the house, which continued open all the winter, has been occasionally mentioned.

The forms of the Aurora are described in such language as occurred at the time, without any regard whatever to theory; but it may be proper to remark that, in reference to Mr. Dalton's opinions, detailed in *Rees's Cyclopædia* (which comprised the whole of my limited reading upon the subject up to the time of observation), I have been more particular in noting the directions of the small slender beams of light of which the masses were sometimes composed, than I should otherwise have thought necessary.

It will be seen that the following observations do not accord with the positions he lays down; that, contrary to his statement, the beams would not always meet in a point if prolonged upwards; that they do not always converge to the place in the heavens to which the south pole of the dipping needle points; and that the rainbow-like arches do not invariably cross the magnetic meridian at right angles.

But, independent of all theory, I think the following notes will at least serve to prove that the Aurora is occasionally seated in a region of the air below a species of cloud which is known to possess no great altitude. I allude to that modification of cirro-stratus which, descending low in the atmosphere, produces a hazy continuity of cloud over head, or fog bank in the horizon. Indeed, I am inclined to infer that the Aurora Borealis is constantly accompanied by, or immediately precedes, the formation of one or other of the various forms of cirro-stratus.

On the 18th of November and 18th of December, its connection with a cloud intermediate between cirrus and cirro-stratus is mentioned; but the most vivid coruscations of the Aurora were observed when there were only a few thin attenuated shoots of cirro-stratus floating in the air, or when that cloud was so rare that its existence was only known by the production of a halo round the moon.

The bright moonlight of December was peculiarly favorable for observations of this kind. Had the nights been dark, many of the attenuated streaks of cloud hereafter mentioned would have been totally invisible.

The natives of this country pretend to foretell wind by the rapidity of the motions of the Aurora, and say that when it spreads over the sky in an uniform sheet of light, it is followed by fine weather, and that the changes thus indicated are more or less speedy, according to the appearance of the meteor early or late in the evening. Our observations were not continued long enough to confirm or contradict these notions; but it may be perhaps worthy of notice that certain kinds of cirro-stratus are also regarded by meteorologists as sure indications of wind and rain.

In reference to Mr. Dalton's opinion that the arches of the Aurora always cross the magnetic meridian at right angles, it may be observed that there is very often an apparent convergence of the parts of the Aurora towards the magnetic east and west, or to some point in their neighborhood; but the light in its passage across the sky, even when it traversed the zenith, very seldom appeared to the eye to describe the segment of a circle, but was either elliptical or formed various irregular curves and flexures.

I think I have on some occasions discerned a polarity in the masses of cloud belonging to a certain kind of cirro-stratus which approaches to cirrus, by which their long diameters, having

all the same direction, were made to cross the magnetic meridian nearly at right angles. The apparent convergence of such masses of cloud towards opposite points of the horizon, which has been frequently noticed by meteorologists, is, of course, an optical deception, produced when they lie in a plane parallel to that on which the observer stands.

These circumstances are here noticed, because if it should be hereafter proved that the Aurora depends upon the existence of certain clouds, its apparent polarity may, perhaps with more propriety, be ascribed to the clouds themselves which emit the light; or, in other words, the clouds may assume their peculiar arrangement through the operation of one cause (magnetism for instance), while the emission of light may be produced by another, a change in their internal constitution perhaps, connected with a motion of the electrical fluid. These crude opinions are offered with diffidence, and my knowledge on these subjects is so limited, that I attach no importance to them; but it appears to me that they would be strengthened were the attempts now making to excite magnetism, by the electrical or galvanic fluid, to prove successful.

Generally speaking, the Aurora appeared in small detached masses for some time before it assumed that convergency towards opposite parts of the horizon which produced the arched form. An observation that I would connect with the previous remarks, by saying that it was necessary for the electric fluid (or the Aurora, if they are the same) to operate for some time before the polarity of the thin clouds in which it has its seat is produced.

This part of the subject, however, is more intimately connected with the interesting observations made on the variation of the magnetic needle by Captain Franklin and Mr. Hood. The object of my notes was merely to record the optical appearances of the meteor.

An electrometer, constructed upon Saussure's plan, placed in an elevated situation out of doors, exhibited no signs of a change from the atmosphere at any time during the winter. The electricity of our bodies, however, at times was so great, that the pith balls instantly separated to their full extent upon approaching the hand to the instrument, and our skins were, in the middle of winter, so dry that rubbing the hands together considerably increased their electricity, and, at the same time, produced a smell similar to that which is often perceived when the cushion of an electrifying machine rubs hard against the cylinder.

The same thing was observed more sensibly in some stuffed quadrupeds that hung in our apartments. Their furred skins, whether rubbed or not, often accumulated such a charge of the electrical fluid, that, when the knuckles were presented to them, they gave a smart shock, which was felt as far as the elbow.

The Aurora did not often appear immediately after sunset. *It seemed that the absence of that luminary for some hours was in general required for the production of a state of atmosphere favorable to the generation of the Aurora.* On one occasion only (March 8, 1821), did I observe it distinctly previous to the disappearance of daylight.

By the way of more perfectly describing one form of the Aurora, rather than with a view of drawing any inference, I shall state that the slender beams of light which compose the Aurora when its motions are rapid, are exactly similar to what would be produced by a quick succession of electric sparks, elicited from a charged cylinder by a body, studded with a row of points, moved rapidly to and fro before it.

Or, supposing a long range of cloud were to commence at one end to impart, from successive points of its surface, its charge to a similar parallel mass, a current of light would be produced, apparently consisting of parallel beams, lying at right angles to its line of direction, as described on the night of the 29th-30th December at 2h. a. m.

Were the clouds supposed to lie in different planes, and to be bounded by curved edges, every variety of form which that species of Aurora assumes might be produced.

The color of the light of the Aurora is not always noted in the following pages, but, when faint, it was generally steel-gray or that of the galaxy.

When the low hazy modification of cirro-stratus appeared in the sky, the light, for the most part, was a gold-yellow color, more or less deep; and when the sky was clear, or when only a few fine threads or thin shoots of cloud were visible, the colors were vivid and prismatic.

I have never heard any sound that could be unequivocally considered as originating in the Aurora;



but the uniform testimony of the natives—both Crees, Copper Indians, and Esquimaux—and of all the older residents in the country, induce me to believe that its motions are sometimes audible. These instances are, however, rare, as will appear when I state that I have now had an opportunity of observing that meteor for upwards of two hundred different nights.”—1 Franklin (Richardson), 599.

NOVEMBER 13, 1890.

“In the evening the sky was covered by a stratum of fleecy clouds, their forms generally orbicular and texture rare. They were separated from each other by intervals of clear blue sky of various extent, but in some points came in contact.

The Aurora was observed to move along these clouds, *strongly illuminating their faces next to the earth*, and very seldom passing across the blue sky, but spreading from cloud to cloud by their points of contact, sometimes slowly, more often with considerable rapidity.

The light was generally brightest in the centre of the cloud, and it often originated simultaneously in various parts of the heavens, more or less distant from each other.

At some moments the whole sky was illuminated.

No distinct beams were seen, and the light had uniformly a grayish color, with a light tinge of yellow.

Thermometer at noon  $+10^{\circ}$ , in the evening  $+8^{\circ}$ .—Ibid., p. 600.

N. B.—1. In the evening the sky was covered by a stratum of fleecy clouds.

2. Aurora was observed to move along these clouds, *strongly illuminating their faces next to the earth*.

3. The light was generally brightest in the centre of the cloud.

NOVEMBER 24, 1890.

“A bright moonlight evening, cloudless sky, with a slight breeze from W. N. W.

An arch-formed Aurora, extending *from S. E. to N. W.* This arch was composed of several dis-united portions of arches, every succeeding one having a higher commencement and termination than that which preceded it, reckoning from the horizon to the zenith.

Their altitude near the centre of the imperfect arch which they formed by their arrangement was from  $40^{\circ}$  to  $60^{\circ}$ .

One of these portions presented a smooth edge inferiorly, or towards the south, but its northern border was fringed with long falcate pointed rays, whose bases appeared to twist together to form the southern edge.

It had a striking resemblance to a shoot of the moss called *dicranum scoparium majus*.—Ibid., p. 600.

N. B.—1. Clear moonlight.

2. An arch-formed Aurora extending from S. E. to N. W.

NOVEMBER 26, 1890.

“Thermometer at noon  $-13^{\circ}$ ; in the evening  $-25^{\circ}$ . Sky cloudless, and of a pretty deep blue.

An Aurora appeared in the early part of the night, having a general direction from *N. W. to E. S. E.* It consisted of several concentric but irregular arches, all of which, without changing their position, occasionally assumed the falcate form observed on the 24th. The uppermost arch nearly reached the zenith. The smaller stars *became invisible* when the brighter parts of the Aurora passed over them.

Although the air appeared perfectly clear during the time the Aurora was visible, yet there was a fall of very small snow. Its particles were so minute as to be scarcely visible to the naked eye, and were most readily detected by their melting upon the skin. The same phenomenon of an almost imperceptible snow falling from a clear sky, had been before observed in a bright sun, which rendered visible a great number of icy spiculae floating in the air.”—Ibid., p. 600.

N. B.—1. Sky cloudless.

2. An Aurora early in the evening from N. W. to E. S. E.

3. It consisted of several concentric but irregular arches.

4. The smaller stars became invisible when the brighter parts of the Aurora passed over them.

## DECEMBER 1, 1820.

"During the day the sky kept tolerably clear, a slight appearance only of the stratus being visible near the horizon; but a snow, whose particles were so minute as to be discerned only in the sunshine, fell at intervals during the forenoon. At noon the snow was more apparent, and a bow was produced in the neighborhood of the sun's place in the heavens. At 8 p. m., wind E. N. E., light, with a very clear sky.

The Aurora commenced by a beam shooting up *from the northern horizon*; afterwards, masses of light appeared in various parts of the sky, particularly *in the eastern quarter*; and at length an arch was formed *from S. E. to N. W.*

The centre of the arch, when it was first formed, lay to the northward of the zenith, but afterwards passed gradually to the southward.

When about  $60^{\circ}$  above the southern horizon, it assumed the falcate appearance described on the 24th of November, the pointed tails directed towards the north. The falciform processes sometimes separated laterally, so as to appear like parallel beams crossing the line of direction of the arch obliquely. Their altitude was not altered at the moment of their separation.

At times the general arch was dispersed, and a number of small arches formed whose ends occasionally rolled inwards upon themselves in form of a scroll.

The whole body of light ultimately descended below the southern horizon and disappeared. Not a cloud was visible during the evening."—*Ibid.*, p. 601.

DECEMBER 4, 1820. Temp.  $-25^{\circ}$ .

"The Aurora forming a broad arch of bright light; its centre about  $45^{\circ}$  south of the zenith, and its extremities bearing *S. E. and N. W.* respectively.

It passed gradually to the southward and disappeared."—*Ibid.*, p. 602.

DECEMBER 5, 1820. Temp.  $-26^{\circ}$ .

"The Aurora to-night had its light disposed in large masses, having indefinite shapes, situated in various parts of the sky, but most crowded in the *southern quarter*.

There were several layers of dark clouds near the horizon.

The Aurora was visible in various spots where no stars were to be seen, but several of the larger stars were visible through a bright arch which at one time crossed the zenith *having a direction from north to south*."—*Ibid.*, p. 602.

DECEMBER 6, 1820. Temp.  $-14^{\circ}$ .

"Aurora in an arch form *passing from S. E. to N. W.* over the zenith, broad towards its middle, but narrow and spirally twisted near the horizon. Stars appeared through it without any perceptible diminution of their brilliancy."—*Ibid.*, p. 602.

DECEMBER 7, 1820. Temp.  $-26^{\circ}$ .

"At ten p. m., the Aurora formed an arch, broader towards its middle, and emitting a denser light from its southern edge, but becoming fainter by imperceptible degrees towards its northern edge, until it disappeared altogether. Its upper or northern edge lay near the zenith.

As its limbs approached the horizon, they became more slender, and assumed a twisted appearance. The stars appeared very dimly through the more dense parts of the Aurora."—*Ibid.*, p. 603.

N. B.—The stars appeared very dimly through the more dense parts of the Aurora.

DECEMBER 8, 1820. Temp.  $-30^{\circ}$ .

"At 11h. p. m., sky very clear, and the stars brilliant. A well-formed arch of light crossed the zenith, *extending from N. W. to S. E.*

It moved slowly to the southward, broke up into several irregular masses of light, and disappeared. At midnight, there was no appearance of Aurora."—*Ibid.*, p. 603.

DECEMBER 9, 1820. Temp.  $-36^{\circ}$ .

"The Aurora made its first appearance at nine o'clock p. m. near the horizon, *in the N. W. by N.*, and shot over to the *S. W.*, forming several concentric arches, the uppermost of which *passed a little to the southward* of the zenith.

As the limbs of these arches approached the horizon, they seemed to be twisted together, and terminated on each side in a single, suddenly acuminate point, about seven or eight degrees high. These extremities emitted a more dense light than the middle parts of the arches, which were rare, and permitted *the stars to be seen clearly through them.*

At 9h. 30m., the moon arose, and the Aurora now formed broken, irregular masses *near the southern horizon.*

At 10h. 30m., a depressed arch of the Aurora was formed, its extremities terminating in the opposite points of the horizon, or in the *N. W. and S. E.*, and its centre *scarcely rising ten degrees above the southern horizon.* It was more brilliant than the former arch, and *completely hid the stars.*

Half an hour after midnight, there were several large masses of light in *the eastern and N. E.* quarters of the sky. The arch had disappeared, but a luminous point remained in *the N. W.*, the quarter from whence it originally sprung.

About 1h. a. m. (10th), several portions of light were arranged so as to form an interrupted arch from *E. to the N. W.* The masses of light before noticed in the *E. and N. E.* had now united, and spread *along the horizon to the S. E.*—*Ibid.*, p. 603.

DECEMBER 10, 1820. Temp. —43°.

“At half past six p. m., an arch of the Aurora appeared having an elevation of 30° and a *direction from W. N. W. to S. S. E.* It was irregularly elevated and depressed in various parts, and its breadth, which was in general about 6°, occasionally expanded so as to occupy thrice that space. These dilatations were effected with a slow motion, and were partial, seldom including more than 10° or 15° of the arch at a time. The centre of the dilating part was more brightly illuminated than the other parts of the arch. The return of the arch to its former dimensions was equally gradual with its dilatation.

The arch was occasionally divided into five parallel beams, which, having a *direction nearly from north to south*, traversed it obliquely.

These beams had a *quick lateral motion*, and were sometimes gathered into masses that receded so far from each other as to break the arch into several portions, which had pointed extremities, arising from the obliquity of the beams which composed them.

The length of the beams was sometimes considerably increased by their northern extremities shooting up whilst their lower ends remained stationary. These appearances were but of momentary duration, the beams rapidly reuniting to form a homogeneous arch.

After the Aurora had continued for about half an hour to display a succession of the above forms, the arch totally disappeared, and a horizontal mass of light was observed in *the southern quarter of the sky*, having its face longitudinally barred by several thin strata of clouds.

At 10h. 30m., there were various irregular masses of light scattered over the sky, but *most luminous in the north.*

The Aurora had appeared early in the night in the *west*; afterwards, its most luminous parts were collected in the *south*. About nine, it shone most brightly in the *eastern quarter* of the sky, and now, as we have just mentioned, its principal seat was in the north.”—*Ibid.*, p. 604.

N. B.—1. The beams had a quick lateral motion.

2. Aurora early in the night in the *west*; then its most luminous parts were collected in the *south*; at nine, it shone most brightly in the *eastern quarter*; at 10h. 30m., its principal seat was in the north.

DECEMBER 11, 1820. Temp. —31°.

“At 5h. p. m., several *broad arches of rare light* appeared, extending from *N. W. to S. E.* At 6h. they disappeared, no change in the weather having occurred in the interim, the sky remaining clear, with a bright moon.

At 9h. an arch was formed in *the east*, broad, irregular, and rather faint. Its extremities bore *N. and S. E.*, and were spirally twisted near the horizon.

At 10h. 30m., there was an arch in *the southern quarter* of the sky, 40° high. Its extremities had

an equal breadth with its centre, and bore *N. W. and S. E.* respectively. Wind a little more northerly; sky clear.

At 11h., two bright arches passed near the zenith in a direction *from N. W. to S. E.*; one complete, extending from horizon to horizon, the other reaching one-half way across the sky, *the west end being deficient*. The edges of both arches were well defined, their apparent acuteness throwing the clear blue sky far back.

The arches were broadest near the zenith; and, when most bright, appeared to consist of several streams of light, nearly but not exactly parallel to each other, and having the same direction with the arch.

These streams receded from each other by a *lateral motion*, leaving interstices, sometimes of a fainter light, sometimes of a clear blue sky; and they were at times gathered together toward one side of the arch, which then shone with a very dense light. The *S. E.* extremities of the two arches were united near the horizon, and, bending to an angle, ran *horizontally to the northward* for a considerable distance.

After the arches had continued for some time, they moved *slowly to the southward*, became rarer and broader, were blended into each other, and finally broke into several irregular masses of light. During the evening, many of the meteors termed falling stars were observed. The Rapid was very loud."—*Ibid.*, p. 605.

N. B.—At 5h. p. m., several broad arches of rare light appeared extending from *N. W.* to *S. E.*

DECEMBER 13, 1890. Temp. —40°.

"At 9h. p. m., there was a broad, faint, irregular arch of light, whose extremities bore *N. N. W.* and *S. E.* by *S.*

At 11h., weather rather hazy, a bur or halo closely encircling the moon. A low arch of light *from E. to S. E.*, and a broad horizontal mass in the north.

At midnight, there were two faint but distinct arches whose extremities, originating and terminating in consort, bore *N. N. E.* and *S. E.* The upper arch had of course a greater curvature. It nearly reached the zenith; the other was about 70° high.

At the same time, many faint and irregular masses of light existed in other parts of the sky. After the circles had remained stationary for a short time, they broke in the middle. The *S. E.* ends disappeared; whilst the remainder, separating laterally into several long streaks of light, shot quickly up in flashes *from the N. W. to S. E.*, crossing the zenith. Sky moderately clear.

About 1h. a. m. (18th), there were many masses of light in various parts of the sky, which bore a strong resemblance to assemblages of the clouds denominated cirro-cumuli.

At one time, a remarkable body of light appeared in the *N. N. E.*, which occasionally split into detached parts by a lateral recession, but its general motion was *directly to the S. W.* It obscured the smaller stars, but did not completely hide those of the first magnitude."—*Ibid.*, p. 606.

N. B.—1. At 9h. p. m., a broad, faint, irregular arch, *N. N. W.* to *S. E.* by *S.*

2. It obscured the smaller stars, but did not completely hide those of the first magnitude.

DECEMBER 13, 1890. Temp. —34°.

"At 1h. a. m. (14th), a broad arch of faint light, crossing the zenith, extended from horizon to horizon, its extremities bearing *E.* and *W.*

A meteor, termed a falling star, was observed at this time. It remained luminous until it came below the near side of a tree-top at no great distance.

When the arch broke up, its west end disappeared entirely, but its eastern extremities assumed for some time the semblance of a group of cirro-cumuli."—*Ibid.*, p. 607.

DECEMBER 14, 1890. Temp. —16°.

"At midnight, a faint arch extended from the horizon in the *S. E.* by *E.* to the *N. W.* by *W.*, its centre passing to the southward of the zenith. Bright moonlight."—*Ibid.*, p. 607.

DECEMBER 17, 1890. Temp.  $-30^{\circ}$ .

"At 1h. 30m. a.m. (18th), a number of detached irregular masses of light were so arranged as to form an arch  $30^{\circ}$  high, having a direction from *N. W. to S. E.* Weather clear, strong wind."—*Ibid.*, p. 668.

DECEMBER 18, 1890. Temp.  $-37^{\circ}$ .

"At 11h. 30m. p.m., the sky, which had previously been clear, was covered by a thin stratum of clouds belonging to that modification of cirrus which forms the mackerel sky of sailors, conjoined with small portions of what are termed by the same people mares'-tails. Between the bars of the former and the long fringes of the latter, streaks of deep-blue sky appeared.

These clouds were not dense enough to hide the larger stars completely, and from their first appearance until they spread entirely over the sky, not more than a quarter of an hour elapsed.

On attentively regarding the sky for some time, the more rounded parts of the mackerel sky were observed to send shoots across the blue spaces to unite with similar processes of the neighboring masses. At the moment of junction, a yellowish light, with a slight tinge of red, was emitted most brightly from the centres of the two clouds, but extending, though more faintly, to their margins. A longer space of time had not elapsed than was required to note down these appearances, when an arch of light was observed to cross the zenith, its extremities bearing east and west, and terminating about  $50^{\circ}$  from the horizon. It was from  $3^{\circ}$  to  $4^{\circ}$  broad, and had a pale gold-yellow color. When it ceased to emit light, its site was seen to be occupied by a range of small fleecy clouds, similar to those already described, but more closely aggregated. The moon now bore nearly south, and shone brightly, strongly illuminating the arch-formed range of clouds just mentioned; but their rarity was such that they showed no dark sides. Winds very variable from *S. W. to W.*

About a quarter of an hour after the last observation, a round mass of cloud in the *S. E.* was observed to assume, suddenly, an appearance of greater density, at the same time emitting from its centre a yellowish light. Immediately after which, it shot forth towards the *S. E.* several bright parallel horizontal streaks of light, which, crossing the near face of a neighboring mass of clouds, became slightly curved from the south. They were about  $8^{\circ}$  or  $10^{\circ}$  above the horizon, and were prolonged after passing before the clouds, through a portion of clear sky. A few degrees beneath them, there were two or three dark layers of cirro-stratus.

The clouds, in their general arrangement at this period, had that appearance of convergency in opposite points of the horizon which has been frequently noticed in a sky covered with cirri. In the present instance, these points were at right angles to the magnetic north and south. In the zenith, the mackerel sky prevailed; but in the *S. E.* and *N. W.* (true), the clouds were more dense, and presented various depending fringes towards the points of the horizon already mentioned. The magnitudes of the masses, too, in different parts of the sky, diminished so regularly, as they receded from the zenith, as to convey an idea that their long sides were seen in the *N. E.* and *S. W.* quarters of the sky, but their ends only in *N. W.* and *S. E.* quarters.

At midnight, several of the cirriform clouds, which were in the neighborhood of the moon's place, reflected her light strongly, and hence appeared to have a pretty dense structure; but when they passed before the face of that luminary, they became nearly invisible, producing only a slight halo or bur, but not sensibly diminishing the light.

At 20m. after midnight, the northern quarter of the sky became perfectly clear to the height of  $85^{\circ}$ , the rest of the heavens being overspread by small fleecy clouds, separated by narrow intervals. The edge of cloud bordering on the clear sky was well defined, ran east and west, and was made up of the ends of small and rather broad parallel bars, having a direction from north to south; a very common modification of cirrus. The moon was at this time wading through a collection of small clouds, and was surrounded, at the distance of  $10^{\circ}$ , by a faint though distinct halo. In the *S. W.*, in a clear part of the sky, there existed a small spot of yellowish-white light, which, for a few seconds, gradually increased in brightness, and then sent forth suddenly a luminous beam, which, crossing a portion of the deep-blue sky, passed over the well-marked edge of cloud above described, continued its course in front of the clouds, brightly illuminating their faces, and terminated to the southward of the zenith, near the moon's place in the heavens.

When this beam had attained its extreme length, it formed a half-arch concave to the westward. It was scarcely formed, however, before it divided into a number of small parts, which, being segments of circles and rising successively one above the other, formed a kind of tiled arch. It disappeared altogether in three or four minutes, leaving the clouds unaltered in appearance.

At 12h. 40m., the sky had become clear as far as the zenith. The edge of the clouds, which were now overhead, was still composed of parallel bars directed to the north and south. Under these bars, a few streaks or threads of very rare cloud were seen floating, and at times emitting a faint orange-colored light. The clouds in the southern part of the sky, although they appeared pretty dense in the bright moonlight, were yet rare enough to allow the larger stars to appear through them.

By one o'clock, the whole mass of cloud had gathered together towards the south, and disappeared in the horizon; but, at the same time, a few long and very rare threads of cloud, which were at intervals faintly luminous, shot athwart from east to west in the deep blue of the northern part of the sky. On former occasions, the Aurora had been observed to illuminate the face of the clouds next the earth; but the present night was remarkably favorable for the observance of that phenomenon, the brightness of the moonlight, and the clearness of the sky, rendering the clouds very visible and well defined."—*Ibid.*, p. 609.

DECEMBER 19, 1820. Temp. —38°.

"At midnight the sky cleared up, a few cirro-strati were seen to the southward, and there was a slight bur round the moon. The rest of the sky was of a grayish blue color.

At this time, a broad bank of the Aurora appeared in the north, lying horizontally, at an elevation of 25°. There were also a few long parallel streamers to the westward, flashing in the direction of their lengths from W. by N. to E. by S. They disappeared suddenly, leaving in their site a faint yellowish light."—*Ibid.*, p. 611.

DECEMBER 20, 1820. Temp. —46.6°.

"At 10h. 45m., bright moonlight. The sky, which had previously been very clear, was suddenly overspread by a thin stratum of fleecy clouds. They were in general orbicular, but were much crowded, so as to leave only small interstices of clear blue sky. A few stars were visible through the rarer parts. About 7° or 8° above the northern horizon, there existed a mass of cloud rather more dense, which began soon after its formation to emit a faint yellowish light. In two minutes, the light became brighter, and spread towards the S. W. by a slow waving motion, like an increasing volume of smoke rolling parallel to the horizon. It continued sweeping round the sky in this manner until the produced end bore N. W., and then became irregularly elevated in the middle, assuming an arched form. At the instant at which this elevation took place, a stream of light, issuing from the S. W., formed an arch about 2° higher than the other, and parallel to it. The second arch exhibited nearly the colors of the rainbow.

The red color occupied its under edge, and it darted down towards the inferior arch a number of light-red, fringe-like processes. The two arches were scarcely formed when they disappeared, but instantly appeared again, and continued to do so, in rapid succession, for a minute or two; the upper one retaining its prismatic tints, and the under one an uniform pale-yellow color. The motion of the light by which the arches were reproduced was sometimes from right to left, sometimes in the opposite direction. The upper arch, too, was occasionally split into narrow parallel beams, which had not only a rapid lateral motion in the direction of the arch, but were also lengthened out, both upwards and downwards, by sudden flashes. At such moments, the colored tints were most vivid; the red always predominating.

About five minutes after the first appearance of the Aurora, a bright mass of light was observed bearing N. N. W., from which a column, possessing prismatic tints, shot up as high as the zenith; a similar column at the same time springing to meet it from the site of the two arches which had now disappeared. A brilliant arch was thus formed, whose extremities bore W. N. W. and S. S. E. In an instant thereafter, the whole sky was covered with small arcs and irregular masses of light, mostly composed of short parallel beams. These masses moved rapidly from the horizon towards the zenith, and back again. The duration of this phenomenon was about seven or eight minutes, when the light wholly disappeared.

The colors of the arches, in their general appearance and arrangement, resembled those of the rainbow; but the blue, green, or violet, were not distinctly visible. The yellow ray occupied most space and was the faintest, whilst the orange was the brightest. The red was nearly as abundant as the yellow, and approached in its hue to lake-red. The moon shone brightly all the time. After the disappearance of the Aurora, the sky remained as before, covered with a thin stratum of clouds, but their texture had become more rare, their edges worse defined, and their masses more blended into each other. In short, they answered the description of the cirro-stratus in the first stage of its change from the cirrus. The moon had a bur or halo round it; and a candle, both in the open air and the house, was also surrounded by a halo.

At 11h. 30m., there was a faint mass of light in the S. S. W., about  $20^{\circ}$  high, occasionally fading away, and allowing a body of dark cloud to appear in its site. The light reappeared first in the centre of the cloud of a gold-yellow color, but became fainter as it spread outwards.

At midnight, the weather was rather hazy, and there was very little blue sky to be seen. A few minutes before twelve, a portion of cloud in the S. E. was faintly illuminated; and, at the same instant, a luminous spot made its appearance in a clear blue space in the north, about  $15^{\circ}$  high. From this spot, an arch shot up which, passing to the eastward of the zenith, joined the luminous cloud in the S. E. The arch was scarcely formed when it disappeared, but was as speedily formed again by a mass of light rising in the S. E., and rolling to the north like a volume of smoke from a chimney, increasing in dimensions as it rose. Immediately after the second formation of this arch, it assumed that appearance of a shoot of the moss alluded to in the notes on November 24th, and which is termed by botanists *falcato-secund*. The points of the rays or streams were directed to the south. In a short time, the arch separated into small curved segments, which vanished in their turn; and the attention was next directed to the formation of a long range of prismatic light about  $60^{\circ}$  high, its extremes bearing west and north. This light had a pale gold-yellow color, and was attenuated towards the north, its southern or upper edge being brightest. When this passed away, a number of irregular masses appeared in various parts of the sky. At 1h. a. m. (21st), the sky was obscured by a fog."—*Ibid.*, p. 612.

DECEMBER 21, 1820. Temp.  $-42^{\circ}$ .

"During the early part of the evening, there were a few thin horizontal clouds in the N. E., but the sky in general had a clear grayish-blue color. Some streaks of cirrus were faintly visible in the east. The moon shone brightly, but was surrounded by a bur, as was also the candle. Rapid noisy.

At 10h. 20m., the Aurora rose in the S. S. E., and, proceeding across the sky, divided into several broad arches, which terminated about  $80^{\circ}$  from the western horizon. The common stem in the S. S. E. appeared as if formed by the twisting of the ends of the different arches together, and had a waving irregular motion, sometimes apparently doubling upon itself; and once or twice it separated into small parallel portions, having a lateral motion in the direction of the arch, but with their ends pointing north and south. The arches were three, and at one time four, in number, and gradually diverged more and more from each other towards their western ends. The uppermost passed a little to the southward of the zenith, and they were each about  $4^{\circ}$  or  $5^{\circ}$  broad. The spaces between them were sometimes faintly illuminated. After they had continued stationary for about ten minutes, the S. S. E. common stem moved slowly round the horizon until it bore south, leaving a streak of light behind it, whilst the truncated ends, or those which were directed towards the western horizon, approached each other, and were lengthened out to the horizon in the W. N. W. by the rolling motion of smoke. Contemporaneously with these motions, the centre of the arch moved up and down, so as to appear undulated and even contorted; the moving parts frequently dilating considerably, and always becoming brighter in the centre, at the commencement of their motion. The light had a pale yellow hue, and, when brightest, was not sufficiently dense to hide the larger stars. Its motions were in general slow, and unattended by flashes.

At 11h., a bright arch extended across the zenith from E. by S. to N. W. by W.; the S. W. quarter of the sky being at the time occupied by a homogeneous mass of light, which had a crescentic edge turned towards the east, and there was a similar mass in the north concave towards the

south. The arch at first exhibited a vermicular motion from east to west, then split into parallel beams, possessing, as usual, a rapid lateral motion; and, in a short time, the Aurora in every part of the sky began to move with such velocity, and to assume such a variety of forms, as to defy description. The central arch more than once exhibited two distinct currents, or motions of its parts, flowing from one end to the other in opposite directions at the same instant; and at one time all the detached parts of the Aurora appeared to collect together to form a beautiful circle or corona, which surrounded the zenith at the distance of  $45^{\circ}$ , and in which the rapid lateral motion of the beams was very apparent, having a direction from north, round by the south, west and east. The beams, in this case, were apparently perpendicular to the earth's surface in every part of the luminous ring which they formed. In a half arch, which rose immediately afterwards from the northern horizon to the zenith, the extremities of the beams were directed from east to west, and the ranges of beams which formed, in rapid succession, masses of light of various shapes in every part of the sky, had no certain direction. The general color of the Aurora was a pale yellowish-gray; but when the beams moved with a rapidity that could scarcely be followed with the eye, they emitted a pale but bright red light, slightly tinged with purple or violet. These beams sometimes lengthened and shortened themselves with extreme rapidity, and the prolonged extremities emitted a light equally brilliant, and of the same hue, with the rest of the beam. In about fifteen minutes, the whole of these beautiful phenomena vanished, leaving behind only a few faint masses of light. The moon was still surrounded by a slight bar, and the wind had changed to the west.

At midnight, the southern quarter of the sky was occupied by a broad horizontal mass of light.

At 1h., there was no appearance of the Aurora whatever. Sky cloudless, but rather hazy; minute crystals of snow falling. During the evening, the wind was very variable, but light."—*Ibid.*, p. 614.

DECEMBER 22, 1820. Temp.  $-43^{\circ}$ .

"At 4h. 30m. p. m., dark and rather cloudy. A faint mass of the Aurora in the *E. S. E.*, about  $20^{\circ}$  high.

At nine o'clock p. m., the sky being of a pretty deep-blue color, except in the *S. E.*, where there was a mass of white clouds near the horizon, the Aurora appeared in the form of an arch of yellowish-gray light, about  $70^{\circ}$  broad in the centre, where it reached from the zenith to within  $29^{\circ}$  of the southern horizon. Its limbs were spirally twisted and tapered, touching the horizon in the *S. E.* by *S.* and *N. W.* by *W.* The light of this arch was arranged in longitudinal bands, having different densities, and varying in length from  $20^{\circ}$  to  $80^{\circ}$ . These long portions of light occasionally receded laterally from each other, and then formed a series of arches or parts of arches, the upper ones including those beneath them. Whilst the arches were thus separated, some of them exhibited a waving lateral motion, the others remaining stationary, and sometimes, one end of an arch moving more than the other, it was carried obliquely across the general line of direction of the parts of the large arch. The arches approached each other by an irregular, slow, lateral motion, occurring simultaneously in the different arcs, and again formed a continuous body of light, varying in density in different parts.

At 11h., a beam of light rose from the southern horizon to the height of  $45^{\circ}$ , where it terminated, that end then bearing *N. W.* by *N.* It was about  $10^{\circ}$  broad, and gradually attenuated from its centre outwards.

At 11h. 30m., there was a long luminous beam in the south, nearly of equal dimensions throughout. Its centre was slightly elevated, and about  $40^{\circ}$  high. Its extremities faded imperceptibly away in the *S. S. E.* and western parts of the sky. It was about  $6^{\circ}$  broad, and emitted a greenish-yellow light. The sky near its extremities was dark, and completely hid the stars. Five or six degrees below this nearly horizontal mass, a smaller but similar one appeared for a short time. Neither continued above two or three minutes, and they exhibited no quick motions, but merely brightened a little, undergoing at the same time a slight dilatation. They appeared, however, and disappeared at intervals until 2h. a. m. (23d), when a haziness overspread the sky."—*Ibid.*, p. 616.



DECEMBER 23, 1820. Temp.  $-45^{\circ}$ .

"At 11h. p. m., a faint arch of pale greenish light, about  $10^{\circ}$  broad, rose to the height of  $30^{\circ}$ . One of its limbs, bearing *S. E. by S.*, sprung from a collection of whitish clouds (cirri) situated about  $10^{\circ}$  above the horizon. The other, bearing *W. by N.*, faded away imperceptibly in a dark part of the sky, where there were neither clouds nor stars visible.

The moon was surrounded by a bur, and did not give much light.

At 12h., the arch was still visible, but several strata of pretty dense white clouds now occupied the southern part of the sky to the height of  $20^{\circ}$ , and the extremities of the arch, which were broader and fainter than before, bore *S. by E.* and *W. N. W.*

In the middle of the arch, there were several gentle elevations and depressions; but, although the light occasionally brightened up in some spots, there were no quick motions amongst its parts.

The state of the atmosphere continued, as before, pretty clear in the zenith; but the bur round the moon, of a faint gray color, with a slight tinge of orange on its outer edge, remained. A similar bur was formed round a candle, its diameter enlarging rapidly as the observer receded from it."—*Ibid.*, p. 617.

DECEMBER 25, 1820. Temp.  $-28^{\circ}$ .

"At 1h. a. m. (26th), the Aurora appeared for the first time this night, in form of a faint arch, extending from the altitude of  $40^{\circ}$  in the *N. W.* to a spot near the zenith, bearing *S. E.*

It was composed of longitudinal bands or streams of light, connected with each other by a faint luminousness.

A little snow was falling at this time in minute crystals, and there was a slight haziness in the sky."—*Ibid.*, p. 618.

DECEMBER 26, 1820. Temp.  $-32^{\circ}$ .

"At 10h. 30m., an arch-formed Aurora, about  $8^{\circ}$  broad, appeared a little to the southward of the zenith. Its extremities descended to within  $15^{\circ}$  of the horizon, and terminated in the *S. E.* and *N. W.* At one time, the light of the arch appeared of uniform density throughout; at other times, it was most intense along its southern or lower edge, and became gradually fainter upwards until it disappeared.

The stars were seen obscurely through the denser light; in other parts of the sky they shone brightly. At the same time, there appeared in the *E. S. E.*, parallel to the horizon, a mass of bright light with two or three dark horizontal streaks across its face, produced apparently by intervening layers of cloud. The arch continued for a considerable time without undergoing any material alteration in its appearance, except that it occasionally brightened up and faded away again. Once, indeed, for a few moments, it separated into portions parallel to each other, but having about  $11^{\circ}$  of obliquity with respect to the arch. These portions emitted a bright light, and were separated by faintly luminous spaces.

At 11h., the arch, having nearly the same direction as before, was composed throughout the greater part of its length by two parallel portions, each gradually fading away towards their edges; and the *S. E.* end of the arch was also lengthened out and bent towards the east, so as to come in contact with the mass of light noticed above as bearing *E. S. E.* This bent portion of the arch was composed of several bars nearly of equal length, and arranged so that every succeeding one lay to the north of that which preceded it in their approach to the horizon. The whole were connected together by a faint diffused light; and from the same body of light in which that end of the arch now terminated, a column of faint beams rose perpendicularly to the height of  $15^{\circ}$ .

At 11h. 20m., the arch had increased its breadth to  $20^{\circ}$ , its northern edge being very near the zenith. Its extremities, bearing *S. E.* and *N. W.*, were composed of irregular and somewhat detached roundish masses, but its centre consisted of five bright longitudinal bands, connected by a faint diffused light. The mass of light formerly bearing *E. S. E.* had now moved round towards the south, and, still resting in the horizon, formed the *S. E.* end of the arch.

At midnight, a great number of detached masses of light occupied the sky from  $20^{\circ}$  south to  $10^{\circ}$  north of the zenith. These masses of light varied in shape, but the greater number had somewhat of an oblong form. They were separated in some places by clear blue sky, in others they

were connected by a diffused light. They lay in various directions in the zenith, but towards the horizon they had an appearance of convergency to the N. W. and S. E., and thus formed in the aggregate an arch  $30^{\circ}$  high in the middle, and tapering towards its extremities.

At 1h. 30m. (27th), the centre part of the above-mentioned arch, or aggregated masses of light, had dilated so as to occupy the whole sky, except a clear blue space of  $20^{\circ}$  from the northern horizon. The shapes of its component parts had undergone a material alteration, and were now so arranged and blended together as to bear a striking semblance to an immense double curtain with its ends gathered together, in the N. W. by W. and S. E., at about  $10^{\circ}$  above the horizon, the space beneath being of a clear blue. From the zenith, to carry on the similitude, the folds of the curtain proceeded in several beautiful festoons towards the north and south, and had occasionally a slow motion, as if it were folding and unfolding again and again. The moon at this time shone with a bright light, and illuminated several layers of cloud (cirro-stratus) in the N. E., every other part of the sky being unclouded.

At 2h. a. m., a large homogeneous sheet of rare light was spread over  $20^{\circ}$  on each side of the zenith, and near the horizon there were many layers of cirro-stratus, some of them pretty dense, so as to obscure the moon when they passed over its face. The Rapid was quite inaudible at this time."—*Ibid.*, p. 618.

DECEMBER 27, 1820. Temp.  $-45^{\circ}$ .

"At 11h. p. m., the sky clear, the moon not yet risen, but many stars visible. A beam of light, about  $8^{\circ}$  broad, rose from  $10^{\circ}$  above the horizon in the S. E. by S., and, gradually becoming fainter upwards, disappeared a little south of the zenith. After continuing stationary for some time, it sent forth a beam of light from its southeast end, which extended  $11^{\circ}$  more to the northward, whilst its fainter end was at the same instant prolonged so as to form a complete arch, terminating in the N. W. by W. horizon. A little haze was visible at this time in the southern horizon.

At midnight, the Aurora formed a somewhat interrupted circle round the sky, about  $15^{\circ}$  high, which sent down, from its N. W. by W. and S. E. points, several pointed processes which nearly touched the horizon. Some large flexuous streaks, and masses of light traversing the zenith, connected the northern with the southern part of the circle; and there were also a few detached irregular masses of light in other parts of the sky. The best-defined part of the circle was in the N. E. quarter, and here a quick lateral motion to and fro was produced, as if by its separation into perpendicular bars. It was about  $8^{\circ}$  broad at this place. During the continuance of this phenomenon, many beams of light rose perpendicularly from the upper margin of the circle, but, before they reached the zenith, their extremities were bent from their course so as to make various curves sideways, or even to appear as if rolled up upon themselves.

When the Aurora had exhibited itself in this form for a considerable space of time, the whole mass of light suddenly appeared in motion, and, sweeping round on each side, was gathered together to the southward of the zenith. Immediately thereafter, a large portion of it was seen in the S. E., assuming an exact resemblance to a curtain suspended in a circular form in the air, and hanging perpendicularly to the earth's surface. The lower edge of this curtain was very luminous, and had a waving motion; and the illusion was further heightened by the momentary appearance of perpendicular dark lines or breaks in the light, in rapid succession round the circle, exactly as the waving of a curtain would cause the dark shades of its folds to move along it. This beautiful curtain of light was about  $40^{\circ}$  high, of a pale yellowish color, and sent forth on the one side a process which approached the S. E. by E. point of the horizon, and on the other was connected with a long regular arch, terminating in the N. W. horizon, similarly constructed, and having the same waving motion with the curtain itself. All this time the sky was perfectly clear, except in the southern quarter, which, to the height of  $4^{\circ}$  or  $5^{\circ}$ , was occupied by dark clouds, apparently intermediate between stratus and cirro-stratus.

Half an hour after its first appearance, this curtain-formed Aurora was resolved into a number of detached irregular portions, which sometimes increased rapidly in every direction until they met with other masses, either before existing or appearing at the instant, and formed an uniform sheet of light which covered the whole sky. The formation of this great sheet of light was so rapid,

that the eye could only trace its progress partially; and its dissolution and reappearance were equally sudden.

At 2h. p. m., the moon arose. A clear sky. The Aurora fainter and further to the southward than before."—*Ibid.*, p. 620.

DECEMBER 28, 1820. Temp.  $-49^{\circ}$ .

"At 6h. p. m., the Aurora, in an arched form, extended from the S. E. horizon to the N. W., across the zenith. This arch was at one time composed of a bright homogeneous stream of light about  $8^{\circ}$  broad; at other times, it split into parallel beams, their ends directed to the east and west. These beams receded from each other laterally, until they were separated by a space of clear blue sky more than twice their breadth, speedily reuniting again, however, to form the uninterrupted arch. A fainter arch appeared to the northward of the other, springing from, and terminating at, the same points in the horizon, but having an apparent curvature so much greater as to keep their centres  $5^{\circ}$  or  $6^{\circ}$  apart.

At 8h., the low fog to the southward had increased, and minute crystals of snow were falling, but the zenith remained clear.

At this time, there existed a zone of light in the north, about  $20^{\circ}$  high, whose extremities, united with those of a similar zone in the south, dipped suddenly down to the horizon in the S. E. and N. W. points.

At 9h., in a calm and clear atmosphere, there were five arches, each about  $4^{\circ}$  broad; one crossed the zenith, another was elevated about  $60^{\circ}$  above the northern horizon, and there were three in the southern half of the sky, at elevations of  $45^{\circ}$ ,  $6^{\circ}$ , and  $80^{\circ}$ . Their light was faint, and their extremities converged so as to terminate conjointly in the N. W. by N. and S. E. by S. points.

At 10h. 30m., columns of faint light rose perpendicularly from the horizon in the N., S. E., and S. W. points, to the height of  $20^{\circ}$ .

At midnight, there was an arch of light in the south, about  $15^{\circ}$  high, having its lower edge, throughout its whole length, resting upon a fog-bank; and there were also two or three faint beams rising from the horizon in the S. E., across a portion of clear sky, and a beam lying midway between the zenith and horizon, about  $20^{\circ}$  long, and pointing north and south.

At 1h., the sky in the zenith was clear, and was occupied by an arch tending from N. W. to S. E."—*Ibid.*, p. 622.

DECEMBER 29, 1820. Temp.  $-52^{\circ}$ .

"At 6h. p. m., there appeared an arch of yellowish-gray and pretty dense light, about  $10^{\circ}$  broad and  $25^{\circ}$  high, which in a few minutes began to increase in breadth, and at length separated into two parallel arches, whilst at the same time a fainter beam sprung from its northern end, taking a direction towards the S. by E., but, becoming more diffuse as it rose, it disappeared in the zenith. The brighter part of the light obscured the stars. The united limbs of the two arches in the N. by W. were divided by perpendicular dark spaces so as to appear to be composed of oblique bars.

About 10m. after these appearances were noted down, the sky was occupied, for about  $70^{\circ}$  to the northward of the zenith, by large masses of light, arranged so as to converge towards the N. W. by N. and S. E. by S. points of the horizon. Near these points, long slender processes of light descended, and united so as to form a common stem on each side similar to the limbs of an arch of the common dimensions of  $2^{\circ}$  or  $3^{\circ}$  in breadth. The internal movements of the Aurora at this time were sluggish, but large masses of light were frequently generated almost instantaneously.

At 7h. 30m., a number of arches sprung from the horizon in the N. W. by N., and, sweeping across the sky in various directions, suddenly curved in to terminate in the S. E. by S. The arches were in general about  $6^{\circ}$  broad, and their middles were distant enough from each other to spread on each side of the zenith to the distance of  $50^{\circ}$ .

From 9h. to midnight, the Aurora formed many arches of light, very various in breadth and density, all having a common origin and termination in the N. W. and S. E., but crossing the heavens in a variety of directions, so as to occupy about three-fourths of the space on each side of the zenith.

The middle portions of some of these arches ran horizontally across the sky, whilst their extremities, making sudden curves, arrived at the common origin and termination of all the arches, which were seated for the greater part of the night about  $4^{\circ}$  above each horizon. At one time, the light was arranged in a series of curves, including each other and having their convexities turned towards the north on both sides of the zenith. In short, their arrangement was continually varying, but the breadth of the arches at all times was greater in the zenith. Large and diffuse columns of light sometimes shot up at right angles from the convex side of the arches, and portions of broken arches were occasionally seen in various parts of the sky, lying obliquely across the general line of direction. The changes of form were not produced by a quick flashing motion, but by the different parts of a new arch appearing simultaneously but faintly, then gradually brightening up in a manner that could be traced only by keeping the eye steadfastly fixed on a clear part of the sky and watching the evolution of the light there.

At midnight, a clear blue sky surrounded the zenith to the distance of about  $20^{\circ}$ . The rest of the sky had a light-grayish appearance, resembling the light of the milky way; many stars shining brightly at the time. In some spots this diffused light brightened up for a moment or two, assuming at the same time a yellowish hue.

At 12h. 30m., there was an arch in the south about  $15^{\circ}$  high, and various irregular masses of light in the north, the rest of the sky being of a deep blue.

At 2h., the sky very clear. At this time the Aurora was very brilliant, and its motions so rapid that it was impossible to record them in the order of their occurrence with anything like accuracy.

At one period, the S. W. part of the sky was occupied by a mass of dense light, which was connected with a similar mass in the east by a current of light about  $4^{\circ}$  broad, moving with extreme velocity from W. to E. This stream of light bore a stronger resemblance to a cascade of water than to anything else I can liken it to; and it in general flowed from the one mass of light to the other, but sometimes its eastern extremity curled back in various directions, forming, as it were, beautiful eddies. The dark lines or spaces, whose instantaneous appearance and disappearance evinced the motion of the light, lay perpendicular to its line of direction, or pointing to the north and south.

For an instant, when the motions were most rapid, the light became very vivid, and assumed a reddish hue. At this moment, a loud crash was heard, similar to what is produced by a large piece of ice floating down a river and crushing against a stone.

This noise was not repeated, and, as it appeared to come from the river, would not have been noticed unless for its contemporaneous occurrence with the brightening of the Aurora. The air at this time was rather favorable for the transmission of sound, the Rapid being distinctly heard."—*Ibid.*, p. 623.

DECEMBER 30, 1820. Temp.  $-48^{\circ}$ .

"At 5h. p. m., an arch-formed Aurora extended completely across the sky *from the N. W. by N. to the S. E. by E.* From the N. W. end of this arch, a pencil of light rose perpendicularly, and terminated at the zenith. Its hue and brightness were equal to that of the milky way, which was distinctly visible at the time.

At 8h. p. m., two columns of light rose perpendicularly from the horizon, in the N. W. and S. E., to the height of  $10^{\circ}$ . Their summits being connected by a nearly horizontal beam of light, a depressed arch was formed to the northward of the zenith, from various parts of which pencils of light shot up directly towards the south, and rising  $40^{\circ}$  or  $50^{\circ}$ . Portions of two smaller and concentric arches were occasionally seen under the other.

At 9h. the Aurora continued to exhibit modifications of the appearances above described.

At midnight, an irregular mass of light, having a spirally-twisted form, rose in the horizon in the N. W. *by N.* to the height of  $60^{\circ}$ , apparently perpendicularly; then, turning to the northward, it continued its course horizontally across the sky; and, lastly, bent suddenly and obliquely to terminate in the S. E. horizon."—*Ibid.*, p. 625.

DECEMBER 31, 1820. Temp.  $-40^{\circ}$ .

"At 6h. 35m. p. m., an arch-formed Aurora  $15^{\circ}$  high, extremities bearing *N. by W.* and *E. by S.* From its north end, several rays rose to the height of  $10^{\circ}$  or  $12^{\circ}$ , having a direction *to the south.* At 9h., a zone of light, rising from the horizon in the *N. E.*, swept round the horizon to the eastward and southward, with a gradual ascent, until it bore S. W. and had an elevation of  $35^{\circ}$ ; from thence it gradually descended, and finally terminated in the *N. W. by N.* point of the horizon. Near the eastern horizon, this zone was continuous, but towards the south it was composed of thin and parallel layers. At midnight, the Aurora covered the sky in fleecy masses, having the same apparent convergence to the *N. W.* and *S. E.* points that has been described on former occasions."—*Ibid.*, p. 626.

FEBRUARY 13, 1821.

"At midnight, several layers of cirro-stratus in the northern half of the sky with clear blue intervals. A zone of light existed in the north, its extremities bearing *N. W.* and *E. N. E.* It was composed of parallel beams pointing *to the southward*, and having a quick lateral motion. The eastern extremity of the zone was the most brilliant, and it sometimes rolled back upon itself, producing various curtain-like appearances, during which motions it passed in front of the neighboring clouds and completely hid them.

The southern half of the sky was overspread with thin white clouds, through which a few stars appeared. When these clouds passed over the face of the moon, they produced a bur immediately around it, and a halo at the distance of  $15^{\circ}$ . The northern edge of the halo was occasionally illuminated with the yellowish-red light of the Aurora, which gradually faded away into the white moonlight reflected from the cloud.

The zone in a short time broke up, and its parts approached the zenith, often in their course whirling into a circular form with an extremely rapid motion. At those times, the beams of light appeared to be perpendicular to the horizon, and emitted various prismatic rays, of which yellow and pale violet were the most conspicuous. Sometimes the violet merely tipped the beams; at other times it appeared throughout their whole length. When these beams were arranged in the circular form, so as to form a ring, their length varied from  $2^{\circ}$  to  $4^{\circ}$ .

The light appeared this evening, to the eye, *to be near the earth, a thin white haze evidently floating behind or above it*, in some places near the moon's situation in the sky.

The needle, by Mr. Franklin's observations, diverged very much to-night.

A very short time after these observations were made, the whole sky was overspread by a tolerably dense, uniform, hazy white cloud, which hid the stars and considerably obscured the moon. The Aurora shot across this cloud from *N. N. W.* to *S. S. E.*, in the form of parallel arches which emitted a bright yellowish-white light.

The arches were of short duration, and when they disappeared their site was observed to be occupied by the unaltered stratum of cloud."—*Ibid.*, p. 627.

MARCH 8, 1821.

"At 6h. p. m., before the daylight was gone, the Aurora appeared in the *S. E.*, stretching up towards the zenith.

At 7h., two faint arches crossed the zenith.

Twilight. The Aurora was bright and copious all the evening.

At 1h. a. m. (9th), it was extremely beautiful and brilliant, but its changes were too various and rapid to be described. Its intestine motions were curved, waved, and serpentine.

Sometimes it appeared in large masses, like the modification of cloud termed the cumulus; at other times it assumed the curtain-like appearance formerly described; and occasionally it split into beams varying much in altitude, but generally perpendicular to the horizon.

One of its forms was very remarkable. It was a hollow truncated cone of light, formed of rays originating about  $20^{\circ}$  about the horizon, *on every side*, and terminating about  $3^{\circ}$  or  $4^{\circ}$  from the zenith. These rays had much lateral motion, and emitted a most brilliant green light, intermixed with a bright purple. Their convergence was very regular, and, had they been prolonged, they would have terminated in the zenith. The cone was, in fact, the phenomenon we have termed *Corona Borealis*, with beams longer than usual."—*Ibid.*, p. 627.

MARCH 11, 1821.

"At midnight, a zone of light was observed extending from the E. to the N. W., lying about  $20^{\circ}$  above the horizon, and emitting a yellowish-gray light. This zone exhibited some intestine motion, but it was faint, and consisted rather of a brightening up and fading away again of the light than of flashes.

*At this time, sounds were heard* at intervals of from five to ten minutes to a few seconds, resembling the noise of a wand waved smartly through the air. The sounds appeared to issue from various parts of the sky, and as they were frequently simultaneous with a brightening of the Aurora, I was at first inclined to regard them as reports of its motions, but Mr. Wentzel stated them to arise from the contracting of the snow upon the sudden increase of cold, and his opinion was further supported by the same sounds being heard next morning.

We heard in the evening from 50 to 100 of these reports, and they continued nearly as frequent after the Aurora had almost faded away as when it was brightest.

The air was not very favorable for the transmission of sound, as the Rapid was scarcely audible."  
—Ibid., p. 628.

Cape Lavenorn (Greenland).—Lat.  $64^{\circ} 30' N.$  Long.  $89^{\circ} 30' W.$  August 23, 1829. GRAAH.

"This evening, for the first time since April last, we saw the Northern Lights."—Graah, p. 103.

[Graah remained at Nukarvik from October 1, 1829, to April 5, 1830, but does not mention a single appearance of the Aurora.

Nukarvik is in lat.  $63^{\circ} 21' 38'' N.$ , long.  $40^{\circ} 50' W.$ ]

Fort Norman.—Lat.  $64^{\circ} 40' 23'' N.$  Long.  $124^{\circ} 44' 47'' W.$  October, 1849. Lieut. HOOPER.

"16th. At 11h. p. m., a fine Aurora extended in a broad undulating curve from N. E. to W. S. W. The sky was clear; temperature considerably below freezing.

22d. At 11h. p. m., I observed a dim Aurora extending in a segment from N. N. W. to W., at about  $45^{\circ}$  of elevation.

23d. At midnight, Aurora was visible spanning the sky in a broad belt, passing through Orion in the E. and the Pleiades at S. E., and continuing to W. and N. W. Night clear and stars brilliant.

25th. At 7h. 20m. p. m., I saw a very fine Aurora forming a brilliant arch from E. to N. by W. (true), the centre being about  $20^{\circ}$  in altitude. At N. N. W., a column rose from the visible horizon to the zenith, very fine below, and widely outspread above, somewhat in the shape of an open fan which has been much torn in the web. At ten, the Aurora had shifted in position and form, being now extended from S. S. E. through the zenith towards the western horizon, where it formed a magnificent scroll at about  $40^{\circ}$  elevation. It was a most superb spectacle.

The rays of both of these were uncolored, except that they seemed to possess a more brightly golden hue than usual, the moon being nearly at the full and very bright, and the stars brilliantly displayed. The moon went down about eleven, when also the Aurora disappeared, and the sky became entirely overcast.

26th. At 8h. 30m., I observed an Aurora nearly similar in form and position to that first seen last night, but not nearly so brilliant, and of greater altitude, as the inner line of curve was now just above the Pleiades; whereas, in that of last night, at an earlier hour, the upper edge intersected that constellation.

29th. A faint Aurora visible, very nearly in the form and position of that of the 26th instant, with an additional column, irregular and uncertain in form and place.

31st. A fine clear and cold day; a light air from southward, with an almost cloudless sky. The night one of the most lovely I have seen here; perfectly cloudless; the moon high, and, with the stars, very bright; and a beautiful Aurora, in waving tremors, all over the sky; its hue a pale and somewhat yellowish green."—Hooper's Journal, 156.

## NOVEMBER, 1849.

- "3d. The night very fine and clear, and freezing intensely; a slight Aurora to the northwestward.  
 12th. A fine Aurora visible, principally in the south and west quarters.  
 13th. A fine Aurora at night, extending from east, through the zenith, to west, in an irregular curve."—*Ibid.*, p. 158.

## MARCH, 1850.

- "1st. Cloudy; very mild weather; wind moderate, from south. In the early evening, the Aurora was duly displayed from S. to S. W. by W., in a segment of about  $25^{\circ}$  altitude at the centre; vertical short thick rays proceeding from its upper edge. About 11h., the sky cleared, and wind came from E. S. E. moderate.  
 3d. About 10h. p. m., a beautiful broad streak of Aurora extended from N. W., through the zenith, towards S. E., of a pale yellowish green and very bright. Later, it spread all over the sky, and, moving incessantly, threatened an increase of wind.  
 5th. A cold breeze from N. W.; weather cloudy. The night clear and cold. In the early part, an arch of Aurora was visible from S. E. to E. N. E., of inconsiderable altitude and little brilliancy; the rays colored pale yellowish green.  
 6th. Rather sharp in the morning. A fine sunny day, with a fresh breeze from S. S. W. The night very clear and nearly calm. A light vein of Aurora at E. S. E.  
 7th. Very fine and clear; a fresh breeze from the southward. The morning cold. The night fine, clear, and cold. Midnight, a broad wave of Aurora from east, through the zenith, to west.  
 8th. Night fine and clear; a slight Aurora to the eastward. At 10h. p. m., a broad arch of Aurora from E. to N. N. W.; altitude at centre about  $80^{\circ}$ . Calm.  
 10th. In the evening there were visible three bright rays of Aurora, all proceeding from the east; later the Aurora spread all over the sky.  
 11th. The wind has been very unsteady during the day, but blew principally from N. E., especially when strongest. The weather has been exceedingly mild, and even oppressive, despite the strong breeze. At 9h. p. m., the sky was still overcast. There was a dull but distinct arch of Aurora from E. to S. W., the centre having about  $85^{\circ}$  of altitude.  
 13th. At 2h. a. m., there was a fine Aurora spread over the sky, and in particular a *large mass* about  $20^{\circ}$  N. E. of the zenith; the wind was also gentle from N. E., and the sky cloudless; a great deal of *rime* was falling, apparently from the *large mass* before mentioned.  
 The day fine and rather cold. At 10h. p. m., a broad and bright irregular arch of Aurora extended from S. E. to W. N. W., the centre having about  $60^{\circ}$  of altitude. There was at this time a gentle westerly breeze, from which quarter the wind has been all day, light, and a *rime* fell, as last night, and again, as it seemed to me, proceeded from the Aurora.  
 14th. About 11h. p. m., there was an Aurora visible of a pale green hue, extending from S. E. towards W. S. W. in a regular arch, thence swerving to W. N. W.  
 15th. At 1h. a. m., the Aurora changed its position and appearance greatly, now proceeding from E. S. E., in two branches, towards north and west. These united at about  $50^{\circ}$  altitude, N. W. of the zenith, and a large body of light between them passed through the zenith and joined the main branch or stem at their junction, thence a beautiful stream led nearly down to the horizon at N. W.  
 A fine Aurora at 10h. p. m. from E. S. E., through the zenith, to W. N. W., in two broad streams, in vertical waves like a heavy curtain; the lights and shades beautifully alternating, and, as last night, the rays of a pale yellowish green hue.  
 16th. A very fine cold day; wind blowing strongly from N. N. W. until the afternoon, when it moderated. The evening calm, mild, and overcast. A very faint appearance of Aurora at midnight to the S. E.  
 17th. A little snow fell in the small hours, but the day became very fine, sunny, cloudless, and calm. The night fine and very clear. A beautiful pale-green 'curtain' Aurora from east, through the zenith, to west.  
 21st. A very little thin snow was falling this morning when we rose, but it soon ceased, and the day became fine and clear, a moderate breeze blowing from the N. W. The night calm and

clear, with a light bank of clouds on the horizon at south and west; weather very mild. About 11h. p. m., a bright and extensive Aurora displayed itself, in the 'falling drapery form,' spreading from S. E. in a broad path, and passing about  $20^{\circ}$  west of zenith to west; the weather also became colder.

22d. A very beautiful day, but much colder than it has been of late. The evening very fine and cold. An Aurora visible at midnight, similar in position and appearance to that seen last night."

—*Ibid.*, pp. 171-72.

APRIL, 1850.

"2d. At 10h. p. m., a bright Aurora visible from east to west.

3d. At 11h. p. m., a fine Aurora from E. by N. to W. by N.; centre about  $70^{\circ}$  altitude.

4th. At 10h. 30m. p. m., a firm but not brilliant Aurora visible, in parallel arcs, from E. N. E. to N. N. E.; centre of highest about  $25^{\circ}$ .

6th. At 11h. 30m. p. m., calm and very mild. From east up to the zenith a fine Aurora displayed, spread out above like a 'sea anemone.'

I have generally found the weather calm when the Aurora is thus shown in the zenith.

8th. An Aurora at 10h. p. m., similar to that of the 6th.

28th. At 9h. 30m. p. m., there were a few beautiful patches of Aurora to the eastward, colored pale yellowish-green, like the autumnal tint of the fading leaf.

30th. At 10h. 30m., a very faint ray of Aurora, of a pale green hue, extended from the visible horizon at east, towards the zenith, to about  $40^{\circ}$  of altitude."—*Ibid.*, p. 173.

At Sea.—Lat.  $65^{\circ}$  N. Long.  $68^{\circ}$  W. September 28, 1818. ROBERTSON.

"At 11h. p. m., observed the Aurora very brilliant from S. by E. to S. by W. It first appeared from behind a cloud at the altitude of  $5^{\circ}$ , shining with a silvery light; shortly after darting up small bundles of rays to the altitude of  $16^{\circ}$ .

There was no appearance of the Aurora in any other part of the heavens. Weather calm and clear at first appearance; a breeze soon sprung up from west, which shifted to S. W. Moderate weather."—1 John Ross (Robertson), App. 121.

N. B.—1. At 11h. p. m., very brilliant.

2. First appearance from behind a cloud.

3. No appearance of Aurora in any other part of the heavens.

4. Weather calm and clear.

At Sea.—Lat.  $65^{\circ}$  N. Long.  $68^{\circ}$  W. September 29, 1818. ROBERTSON.

"At ten in the evening, the Aurora was seen very brilliant from S. W. to S. E., true bearings, shooting rays to the altitude of  $15^{\circ}$ . In the morning of the 30th, the Aurora was spread all over the heavens.

Strong breezes from westward with clear weather, continuing to blow fresh from that quarter till past noon."—1 John Ross (Robertson), App. 121.

N. B.—1. At 10h. p. m., very brilliant.

2. A. M. 30th, spread all over the heavens.

3. Strong breezes from west; clear weather.

Fort Franklin.—Lat.  $65^{\circ} 12'$  N. Long.  $123^{\circ} 12'$  W. December, 1825. FRANKLIN.

"The length of our shortest day did not exceed five hours, but the long nights were enlivened by most brilliant moonlight, and we had frequent and very fine appearances of the Aurora Borealis



The latter phenomenon made some of its grandest displays on the 26th of October, the 2d of November, and the 7th of December.

On all these occasions, the *disturbed motions of the magnetic needle were very remarkable*, and a most careful series of observations convinced the party that they had a close connection with the direction of the beams of light of which the Aurora was composed.

My observations also led me to conclude that the deviations of the needle were, in a certain degree, connected with *changes in the weather*; for, previous to a gale or a snow storm, the deviations were always considerable, but, during the continuance of the gale, the needle almost invariably remained stationary."—2 Franklin, 66.

N. B.—1. Grandest displays of Aurora.

2. Disturbed motions of the needle on these occasions very remarkable.

3. Deviations of the needle connected with changes in the weather.

Fort Franklin.—Lat.  $65^{\circ} 11' 56''$  N. Long.  $128^{\circ} 12' 44''$  W. February 14, 1826. FRANKLIN.

"On the 14th, at 45m. after nine a. m., the arched form of the *clouds*, and the appearance of a collection of rays projected from the sun's disk in the shape of a fan, strongly resembled the coruscations of the Aurora. The atmosphere was misty; temperature in the shade  $+8^{\circ} 5'$ , and when the thermometer with a blackened bulb was exposed to the sun's rays, it rose to  $+43^{\circ}$ . The *magnetic needle*, at nine a. m., was perceived to have made a greater deviation to the westward than usual at that hour, and I imagine that the cause of this increase probably arose from the atmosphere being then in a state of electricity, similar to that in which it is when the Aurora appears in hazy weather; on which occasions we have observed that its coruscations have the strongest effect in causing aberrations of the needle."—2 Franklin, 72-3.

N. B.—1. Arched form of clouds noticed at 9h. 45m. a. m.

2. At 9h. a. m., magnetic needle was perceived to have made a greater deviation than usual.

Fort Franklin.—Lat.  $65^{\circ} 11' 56''$  N. Long.  $128^{\circ} 12' 44''$  W. 1825-26-27. FRANKLIN.

"The results of the observations on this phenomenon made during the present expedition coinciding with the remarks on the same subject given at much length in the Appendix to my former Narrative, I shall here confine myself to the mention of a few brief deductions from a careful examination of our registers at Bear Lake.

A careful review of the daily registers of the appearance of the Aurora, has led me to form the following general conclusions:—

1. That brilliant and active coruscations of the Aurora Borealis cause a deflection of the needle almost invariably, if they appear through a hazy atmosphere, and if the prismatic colors are exhibited in the beams or arches. When, on the contrary, the atmosphere is clear, and the Aurora presents a steady dense light of a yellow color, and without motion, the needle is often unaffected by its appearance.
2. That the Aurora is generally most active when it seems to have emerged from a cloud near the earth.
3. When the Aurora is very active, a haziness is very generally perceptible about the coruscations, though the other parts of the sky may be free from haze or cloud.
4. That the nearest end of the needle is drawn towards the point from whence the motion of the Aurora proceeds, and that its deflections are greatest when the motion is most rapid. The effect being the same whether the motion flows along a low arch or one that crosses the zenith.
5. That a low state of temperature seems favorable for the production of brilliant and active coruscations; it being seldom that we witnessed any that were much agitated, or that the prismatic tints were very apparent, when the temperature was above zero.
6. That the coruscations were less frequently visible between the first quarter and the full moon,

than in any other period of the lunation, and that they were most numerous between the third quarter and the new moon.

7. That the appearance of the Aurora was registered at Bear Lake, in 1835-36, 343 times, without any sound having been heard to attend its motions.
8. The height of the Aurora was not determined by actual observation; but its having been seen, on several occasions, to illuminate the under surface of some dense clouds, is conclusive that its elevation could not have been very great. When Dr. Richardson and Mr. Kendall made their excursion on Bear Lake, in the spring of 1826, the former saw the Aurora very brilliant and active, displaying the prismatic colors, in a cloudless sky (on the 28d of April); while Mr. Kendall, who was watching at the time, by agreement, for its appearance, did not see any coruscation, though he was only twenty miles distant from Dr. Richardson.
9. The gold-leaf electrometer, which was kept in the Observatory, was never affected by the appearance of the Aurora.
10. On four occasions, the coruscations of the Aurora were seen very distinctly before the daylight had disappeared, and we often perceived the clouds in the daytime disposed in streams and arches such as the Aurora assumes.

The opinions I have ventured to advance above, are at variance with the conclusions drawn by Captains Parry and Foster from their observations at Port Bowen; those officers inferring that the Aurora does not influence the motion of the needle. But the discrepancy may be perhaps explained by the difference in activity and altitude of the Aurora at the two places.

I have stated that the needle is most affected when the Aurora is very active and displays the prismatic colors. Captains Parry and Foster have informed me that the Aurora seen at Port Bowen was generally at a low altitude, without much motion in its parts, and never exhibiting the vivid prismatic colors, or the rapid streams of light, which are so frequently recorded in our registers of its appearance at Fort Enterprise and Fort Franklin. *At both these places, we as often witnessed the coruscations crossing the zenith as at any other altitude, and under such a variety of forms, and in such rapid motion as to baffle description.*

From the difference in the appearance and activity of the Aurora at Port Bowen and Forts Enterprise and Franklin, an inference may be deduced that *the parallel of 65° N. is more favorable for observing this phenomenon, and its effect on the needle, than a higher northern latitude.*"—2 Franklin, cxlv-cxlvii.

N. B.—1. Brilliant coruscations cause a deflection of the needle.

2. Aurora most active when it emerges from a cloud near the earth.

3. When the Aurora is very active, a haziness is very perceptible about the coruscations.

4. The nearest end of the needle is drawn towards the point whence the motion of the Aurora proceeds.

5. A low state of temperature is favorable for the production of active coruscations.

**Fort Franklin.**—Lat. 65° 11' 56'' N. Long. 123° 12' 44'' W. October 26, 1835. FRANKLIN.

"An arch of 20° elevation, extending from W. N. W. to E. N. E. by the north. The motion of the light rushed at the first from the former to the latter point, and then backwards and forwards, and ultimately passed off to the southward. Needle stationary a few seconds. A beam shot along the arch from west by north, to east. Beam from north, across the zenith, to south horizon. Motion of light from W. N. W. along the arch. Motion from N. W. to N. E. at an elevation of 8°. Beam from north to the zenith. Needle stationary, the Aurora having disappeared. Interval of time—between 10h. 10m. and 10h. 30m. p. m.

*Remarks on the 26th.*—These coruscations were extremely brilliant, and in continual motion.

The principal feature was a broad band of light that extended along the northern part of the sky, from W. N. W. to E. N. E., at an elevation of 20°, from which beams of a less intense light were frequently projected across the zenith from north to south, or in the contrary direction; and they sometimes reached the opposite horizon before they disappeared.

The band, as well as the beams, seemed to be composed of an infinite number of slender rays,

which were highly inclined and exhibited the prismatic colors, the strongest tints being red, yellow, and green.

*The whole of these coruscations appeared to be interposed between the spectator and a thin filmy mass of cloud.*"—3 Franklin, cxlviii.

OCTOBER 27, 1835.

"A stream of light extending from E. N. E. to the north, at an elevation of  $15^{\circ}$ . The motion of its parts very rapid.

A beam from north to the zenith. On reaching that part, it instantly spread across the zenith, and its extremities were pointed S. W. by W. and E. N. E.

Another beam from north, which spread across the zenith as the former had done, having its points directed W. by S. and E. by N.

The whole coruscation then disappeared, and the needle gradually recovered its usual position.

Interval of time—from midnight to ten minutes after that hour.

*Remarks on the 27th.*—It should be observed that there were two distinct issues of light from E. N. E. along the above-mentioned stream, which, on reaching the north point, rushed towards the zenith; and, in both instances, similar arches were formed across the zenith.

The needle betrayed the same course of deviation in both cases.

The motion of the light was extremely rapid."—Ibid., p. cxlix.

NOVEMBER 2, 1835.

"Motion of the Aurora rapid from S. S. E. to N. N. W. across the zenith. Arch the same; direction of motion not noted.

Arch across zenith from south to north; motion rapid.

Arch across zenith from N. N. W. to S.; motion N. N. W. to S. Aurora gradually disappearing, and needle stationary at the last position. Interval of time—between 10h. 30m. and 10h. 45m. p. m.

*Remarks on the 2d.*—The Aurora this night was extremely brilliant and active, and exhibited the prismatic tints.

The coruscations commenced with a highly illuminated arch, spreading from S. E. to N. W. across the zenith, in which part it formed a corona, from whence slender rays were projected *perpendicularly downwards*, giving to the coruscation the appearance of a globe with the meridians marked upon it.

This Aurora originally sprung from a mass of cloud bearing S. S. E., which gradually changed its position to the eastward; and, on its reaching the east point, a band of light, resembling the fringe of a curtain, rushed forth and extended round the northern horizon at an elevation of  $8^{\circ}$ .

The corona disappeared at the time this latter change took place, and arches were projected in rapid succession from S. S. E. to N. N. W., E. to N., and from N. N. W. to S.; all of them displaying the most brilliant colors.

The needle betrayed its greatest deviation during the projection of the last-mentioned arches, and was, in fact, kept in a state of vacillation for about five minutes, approaching towards, or receding from, the true north, according to the apparent motion of the rays of light."—Ibid., p. cl.

DECEMBER 7, 1835.

"A bright beam darted from an elevated arch towards the horizon at the N. N. W. point. A stream from E. S. E. to N. W., with a rapid vibratory motion in its parts. Coruscations in the form of a horseshoe; motion following that shape. Interval of time, between 11h. and 11h. 25m. p. m.

*Remarks on the 7th.*—The Aurora this night was very generally diffused, and extremely active and brilliant.

The most remarkable part of the coruscation was three perfect arches, at the several altitudes of  $40^{\circ}$ ,  $50^{\circ}$ , and  $90^{\circ}$ , having the same points in the horizon. From the lowest of these arches, a beam flashed towards the horizon to N. N. W., which produced a change in the needle of  $2^{\circ} 45'$ , as above noted.

When these arches became faint, a mass of light rushed from E. S. E., and in its progress to the

N. W., in an horizontal direction, the rays of light of which the stream was composed were seen vibrating backwards and forwards, between the two extremes, in the most rapid manner. During this commotion, which lasted ten minutes, the needle deviated between  $39^{\circ} 15'$  and  $41^{\circ} 15'$ . It afterwards continued stationary for three minutes at  $40^{\circ} 45'$ , though the Aurora was violently agitated; but the motion of the light was then nearly circular, or in the form of a horseshoe, and confined to the zenith. The color of the light was faint red. In a few seconds afterwards, the whole body of the light, being concentrated in the W. N. W. point, darted in an instant across the zenith to E. S. E., exhibiting in its progress a similar agitation in its rays to that already described. The coruscation then branched off to the north, forming a broad band of light about  $20^{\circ}$  high, reassumed the horseshoe form at the latter point, and its rays undulated through every part of this figure like the waves of the sea or a rolling volume of smoke. During these last-mentioned changes, the needle retraced its course, as shown in the last three notices, and remained stationary at  $38^{\circ} 5'$ , while the Aurora formed a zone that encircled the horizon at an elevation of  $30^{\circ}$ , in which shape it remained a few minutes and then disappeared."—*Ibid.*, p. cli.

DECEMBER 8, 1835.

"Aurora visible. Motion from N. W. by N. along a band of light stretching to the eastward, elevated  $15^{\circ}$  and about  $2^{\circ}$  broad. The colors very vivid; motion rapid. Needle stationary for five minutes at this position. Motion returning from the eastward, along the band, to N. W. by N. The needle stationary at this position for five minutes, during which interval the light was rushing from each extreme of the band, meeting in the N. by E. point. There was but little display of color. The motion from the N. W. prevailed. A stream of light about  $20^{\circ}$  broad darted across the zenith from N. W. by N. to S. S. E. A beam darted from the zenith to N. W. by N., followed by the whole mass that had ascended from this point. Motion along the first-mentioned band from N. W. by N. to the eastward. A stream from N. W. by N. to the zenith. A beam from zenith to N. by E. Needle stationary for some minutes, the motion rolling from opposite directions of the arch that extended from N. W. by N. to east, and clashing in the centre. Motion from N. W. by N., in nearly a horizontal direction, to W. S. W. Stationary for five minutes. A stream of an irregular shape darted from N. W. by N. to S. S. E. across the zenith. Aurora generally diffused in filmy streams without motion. Motion from E. S. E. to N. W. by N. in a band similar to that first described. Interval of time, between midnight and 25 minutes after that hour.

At 1h. 20m. a. m., the Aurora appeared in an arch from N. E. to north, but motionless.

*General Remarks.*—The changes in the coruscations were so various and rapid as to render their description impossible. The band of light first mentioned as extending horizontally from N. W. by N. to the eastward, remained nearly the whole time."—*Ibid.*, p. cli.

Fort Franklin.—Lat.  $65^{\circ} 11' 56''$  N. Long.  $123^{\circ} 12' 44''$  W. November, 1849. HOOPER.

"20th. The day pretty fine and calm. A fine Aurora in the night.

21st. Very fine, clear, and cold. A most splendid Aurora at night, spreading in wavy lines all over the sky."—Hooper's Journal, p. 161.

DECEMBER, 1849.

"4th. Weather stormy, wind strong and squally from N. W. Late in the evening it cleared up a little, and a curious appearance of Aurora was visible to the northward, fringing the upper edge of a heavy 'aëmbus.'

5th. Clear, very fine, and cold. Calm until towards sunset, when the wind rose from N. E. and increased much and quickly, coming in smart squalls, no doubt blowing with great force in an open space, our position being greatly sheltered.

The night fine and very cold; a few windy clouds in the sky. Fantastically flitting rays and streaks

of Aurora visible, darting hither and thither through the heavens like lightning flashes. The stars very bright.

7th. A fine day, calm and very cold. A most lovely Aurora at night, extending from east, through north, to west, with coruscations towards the zenith.

8th. As I have generally observed to be the case, the Aurora of last evening was followed by a strong breeze, the weather completely changing during the night; the clear starlit sky becoming overcast with a heavy drift of clouds from N. E., from which quarter the wind was strong, accompanied by thickly falling and driving snow. The weather continued thus all day, and was, moreover, bitterly cold, but improved a little towards night, the wind and snow ceasing, and a few stars peeping out.

9th. The night was very fine; a gentle breeze from west, a cloudless sky, and a beautiful Aurora; which latter first formed in an arch from N. N. E. to N. N. W., but latter appeared similar to that of the seventh, in broken and vertical rays, coruscating towards the zenith. The stars visible in myriads, and very bright.

11h p. m. I have just come in from viewing (aye, and listening to) the Aurora, which now presents a gorgeous spectacle. It has shifted from its first position, and now covers one-half of the heavens, from east, through south, to west. Oh, it is exquisite! I cannot describe it, for it is too splendid for description, even if viewed by a Byron, but I will try to set down an idea of it, although it can be but a faint one.

Orion is now bearing about S. S. W., and on each side of that constellation to about four points rays are converging very nearly to the zenith, while they are perfectly regular in distance one from the other, and in form remind me of the lines of longitude on a globe, like which, also, they are cut just below the zenith. Around and about them are wreaths and rolls, lines and curves, masses and skirmishers of the luminous fluid, never still for an instant, but waving and rolling, advancing and retiring, folding and unfolding, fast and changeful as thought can fly; never twice alike, but, like the fickle kaleidoscope, ever presenting some new appearance, beautiful and wondrous as those already seen and vanished. The converging curved rays before mentioned are just in shape, &c., as we see in those pictures where the Spirit of God is represented descending upon the Saviour in the form of a dove. I do not think nor write this with levity, for the phenomenon is too awe-inspiring to excite mirth or ridicule.

As the heavy curtain in a theatre is drawn up or let down, so are some of the flying lines expanding and contracting incessantly; others, again, seem heavy breakers, curling and turning under and about. There was one large mass, a perfect blaze of light, which seemed to be not twenty feet above me; others with less body appearing far, far away. It was a glorious sight, and I stood gazing in rapture, although not very poetical, until I found myself chilled throughout; but one who is privileged to view a scene like this can have little soul, little of the spirit contemplative, as he feel not his very heart-strings thrill with solemn joy at the sight.

And now, too, a question long doubted is by me doubted no more. I have heard the Aurora; not once, nor twice, merely, but many times; not faint nor indistinct, but loud and unmistakable; now from this quarter, now from that; now from on high, and again from low down. At first it seemed to be like a field of ice cracking, then like the distant stroke of an axe; again it resembled the noise of pile driving by a monkey, and at last like the whirring of a cannon-shot when heard from a short distance. Once, three like this followed in rapid succession, and I thought I could see the mass whence the sounds proceeded tumbling or vibrating.\*

The night is intensely cold, the sky perfectly clear, the stars showing as brilliantly through the illumined fluid as where the 'lights' are not; the wind is moderate from N. N. W. I have no doubt that we shall have heavy weather after this display. I have read that in other northern voyages, the sound of the Aurora resembles the cracking of a whip, but to-night I heard nothing like this, to my idea.

In a few minutes, the character of the phenomenon changed, the tremors and rays all disappearing, and nought now appeared to view but a long low arch from E. S. E. to S. W., banking a rising

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\* This error respecting the Aurora's sound affords a curious indication of the power of imagination in assisting delusion.

mass of clouds, but I still heard occasionally the sounds as before, now much subdued and less frequent. The night continued calm, but became cloudy.

11th. Snowing and blowing hard all day. The sky clearing a little at night; a fine Aurora was visible, and the wind increased to a strong gale, in which the squalls were very violent.

12th. Still blowing hard all day from the same quarter, N. W., as yesterday; the snow driving fast and furious. The Aurora at night was very fine, the wind having gradually decreased from sunset, and the night became very calm and fine. We again heard the cracking sounds, and our fisherman had a fine laugh at my sounding Aurora, saying that the noise is only that of the ice cracking on Bear Lake; but this solution of the question was not at all to my taste, and I retired to rest perfectly satisfied that it was caused by the Aurora, and not the ice.

13th. Fine and cold, with little wind. All my enthusiastic ideas respecting the Aurora's sound are dispelled, and I find that I have, to use a vulgar phrase 'found a mare's nest,' for those noises which I before heard with so much rapture, as belonging to an exquisite and wondrous phenomenon, were this morning repeated in broad daylight, and are, I now see, unmistakably caused by the ice cracking. A moderate breeze in the evening from N. E.; weather cloudy.

14th. A moderate breeze from N. W.; cloudy and cold. The night set in pretty clear, but with the wind strong and squally from N. W. Late in the night, a fine Aurora was visible to the southward.

15th. Very fine and clear weather; breeze moderate from W. N. W. Towards evening the sky became cloudy, but in the night was clear, and displayed the 'merry dancers' to advantage; the wind being then fresh from westward.

16th. Colder by far than yesterday; very fine, and, in the morning, calm. About midday, a moderate breeze sprung up from N. E., but the night was calm, fine, and clear.

Aurora was visible in; at first, thin bright streaks, and later in a long arch from E. S. E. to S. W.; and another, with less length and of greater altitude, from N. N. W. to N. E. The stars brilliant as gems.

20th. The day was very fine and calm, but the cold penetrated through all covering; even our fisherman was forced to return before his usual time.

At night we saw a lovely Aurora. At one time it was like this, the point being to the eastward, and the flourish reaching half way down to the western horizon, breaking at the extremity into perpendicular lines. The night calm and very fine.

22d. Light melting snow during the day, with a light air from the westward. Last night we observed a fair Aurora; masses of light rolling and tumbling over each other incessantly, and apparently very low. The weather has completely changed since yesterday, being now cloudy and very mild. A slight Aurora to the westward visible this evening.

27th. Very fine, clear, and cold; a fresh breeze from W. N. W. The night like that of yesterday; wind light from west. Our breath was distinctly audible out of doors, and our fisherman got frostbitten on the cheek on returning from the nets. Some time about midnight, a pretty but not brilliant Aurora was visible, of a pale green hue.

30th. Cloudy and mild; a light breeze from the N. W. Read prayers to the party. The evening fine; a moderate breeze from the west. A bright Aurora visible, extending in an irregular semicircle, of considerable altitude at the vertex, from east towards west.

31st. Very fine and not very cold. A fresh breeze from W. N. W. in the morning; the remainder of the day and the evening calm.

A fine Aurora visible this evening, extending from the horizon at N. N. W. to E. by N., its altitude in the centre about  $15^{\circ}$ , with vertical corrugations."—*Ibid.*, pp. 162-65.

#### JANUARY, 1850.

"1st. The Aurora seen last evening changed its position as the moon neared the horizon, progressing before she appeared regularly and gradually towards south.

3d. The breeze continued all day, but with less violence than yesterday. The weather still cloudy and mild. At night, before the moon rose, I observed an Aurora from N. E. by E. to N. by W., over a heavy 'incubus,' at about  $15^{\circ}$  altitude.

- 4th. The day cloudy and mild. In the evening, an Aurora visible from N. by W. to N. E., of which I give one phase; but it was ever changing in appearance.
- 8th. About an hour before daybreak, there was a curious Aurora visible. Late in the day, the wind became fresh, and, accompanied by a fine driving snow, made the weather very cold. The evening was cold, with a little snow; and moderate wind from west. Aurora showing all night, flying about all over the sky.
- 9th. The night was at first very cold, the breath being slightly audible, but later the weather became calm, misty, and much milder. A fine Aurora was visible.
- 10th. At night the wind was fresh, a little snow fell, and the temperature was very low. A faint Aurora visible, similar in form and position to that of last night.
- 11th. The night calm and cold. Aurora during the night to the northward.
- 12th. Before daylight, a fine Aurora was displayed to the southward, afterwards shifting to the north. A moderate breeze from the west.
- 13th. A fine Aurora was visible about three hours before daybreak to the southward; the sky clear. The day very fine, calm, and tolerably mild; a haze on the horizon. Read prayers. The night fine and cold; the breath being audible. Beautiful phases of the Aurora visible during the night in all parts of the sky.
- 14th. Here it was quite calm, but on the Lake there was a very fresh breeze from the west. Very fine appearances of the Aurora all night; uncolored, and inconstant in position.
- 15th. Last night and this morning there fell a sort of rime, which was in so minute particles as to be almost invisible. I fancy this must be frozen dew; perhaps it is this which forms the Aurora by reflection from the snow. The night fine and very cold. Beautiful Auroras throughout.
- 16th. We consider this the coldest day we have had here, the wind being strong and equally from N. E. In the sunshine to-day, I observed the atmosphere crowded with frozen particles sparkling brilliantly, like motes in a sunbeam. All night, beautiful phases of Aurora visible.
- 17th. The night was cold and clear; Auroras showing all night. It is impossible to picture them, so various and inconstant were their positions and forms.
- 18th. Very fine; not a speck in the sky. The sun's warmth is now beginning to be perceptible, but the air is, notwithstanding, very cold. A light breeze from the west. The night fine and cold; Aurora displayed in a very beautiful manner; all the sky from E. S. E., through north, to west, was covered with broken vertical lines in waves converging towards the zenith, and in slight motion. To the southward, was a long low arch, of perhaps 15° altitude at the centre. There was a light northwesterly air.
- 22d. Just after sunset, the wind increased greatly, becoming also squally, and the weather getting correspondingly cold. Beautiful Auroras during the night.
- 25th. Very fine and clear; wind N. W., moderate; the same on the Great Bear Lake; the weather mild. The night very fine, and, late, cold. Beautiful Auroras visible, one of which, extending from E. N. E. to N. W., was shaped like a huge mustache, its centre about 20° north of the zenith. Another appeared as below attempted.
- 27th. The night very fine and very cold, the breath being again audible. Calm on Bear Lake. When the moon had risen to about 12' of altitude, there was a very pretty Aurora about her; the rays tinted pale yellowish-green, which hue I have always observed them to take when the moon is near the full.
- Beautiful 'tremors' all night, moving rapidly over the heavens, and of the same pale-green hue. Whenever I have seen these rapid movements of the Aurora, wind has shortly followed."—*Ibid.*, p. 167.

## FEBRUARY, 1850.

- "1st. Last night was very cold, and Aurora was displayed in a beautiful manner from N. E. to N. in 'tremors' and rolling folds.
- The evening was very cold, fine, and clear. About 10h. p. m., we viewed one of the most exquisite spectacles we ever beheld. The Aurora had been for some time visible, and it now spread over all the sky, excepting to the southward, and kept an incessant motion, whirling, dancing, and darting around with lightning-like rapidity. All the colors of the rainbow were displayed by

turns, visible at one instant, and in the next succeeded by another hue. There was a perpetually shifting fringe, at one moment of an exquisite violet, and then again of a grass-green tint; these were the predominant colors, but all others, in every variety of shade, were here and there shown. A more exquisite or more gorgeous spectacle cannot be imagined. I shall never again begrudge the time spent in our exile here, since in it I have been privileged to enjoy so perfect a specimen of the king wonder of natural phenomena.

We knew very well that this appearance betokened wind, and this rose with the moon about three hours later, the Aurora of course becoming faint as the darkness decreased.

2d. The wind blew freshly all night from the N. E., and did not abate any with sunrise. In the afternoon, it increased considerably, and the sky became covered with clouds; 'cumulus' above, and 'stratus' on the horizon. The weather clear; a slight snow drift.

I am more than ever confirmed in my conviction that the *Aurora is frozen dew or vapor*, illumined by, or rather reflecting, the light of the frozen masses round the pole, or perhaps only by that from the surrounding snow-clad earth. That it must be congealed vapor suspended in the atmosphere and existing in atomic particles, I hold to more than all, from its instant motion with the slightest breeze, and from the resemblance of that motion, when the mass is strongly excited, to that of a cloud of dust raised by a strong breeze; the same eddy-like twisting, the same rolling and folding motion, and of one volume into and over another, &c.

7th. Late last night there were beautiful 'tremors' visible, principally displayed near the zenith. A fresh breeze set in from the N. E., but declined at daybreak.

12th. The Aurora was finely displayed last night in 'tremors,' and this morning there was a strong breeze from the west, with a heavy snow drift.

18th. A strong breeze all day from westward, and a heavy drift, moderating at night, which was fine. Aurora dully displayed in two long arches, one to the north and the other to the southward.

14th. Pretty fine; a fresh breeze from west both here and on the lake; weather not very cold; the night mild and rather cloudy. Aurora displayed in much the same manner as last night, and, towards morning, brightly and in various directions.

15th. Very fine and very mild. The night calm and fine, displaying Aurora as in the early part of last night.

16th. A most lovely day; clear, warm, and sunny, thawing in the sun. A light northerly air here; calm on the Great Lake. In the evening the clouds gathered over to the east and south, threatening wind. In the night, there was a beautiful Aurora all over the sky, in vertical short rays, rolling and folding over each other, while at W. by S. a segment commenced, leading towards the zenith eastward, but breaking and mingling with the mass of Aurora at about 60° altitude."—Ibid., pp. 168-70.

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Duke of York's Bay (Southampton Island).—Lat. 65° 38' 13" N. Long. 84° 40' 07" W. August 15, 1821. PARRY.

"The Aurora Borealis was visible during the whole of the night, consisting of many luminous patches or nebulae, having, when viewed together, a tendency to form an arch, and extending from south by east to southwest, and sometimes to west, its height in the centre being 15°. From this arch, pencils of rays shot upwards towards the zenith.

It differed from any other phenomena of this kind that I have seen, in being at times of a beautiful orange color."—2 Parry, 39.

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At Sea.—Lat. 65° 50' N. Long. 61° W. September 26, 1818. ROBERTSON.

"About nine in the evening, the Aurora Borealis was seen very brilliant in every point of bearing, shooting bundles of rays of unequal length to the zenith.

This Aurora was first seen through a thick mist in the south; as the mist passed away the Aurora



increased in brilliancy; the stars shone bright; not a cloud to be seen. At eleven, the Aurora became less brilliant, and the sky again obscured with mist. The horizon continued hazy till two next morning, when the Aurora was again seen very brilliant in the zenith."—1 John Ross (Robertson), App. 120.

Winter Island.—Lat.  $66^{\circ} 11' 25''$  N. Long.  $88^{\circ} 10'$  W. December, 1821. LYON.

"As we now had seen the darkest, although not by many degrees the coldest, season of the year, it may not be irrelevant to mention the beautiful appearance of the sky at this period.

The Aurora Borealis does not appear affected by the brilliancy even of the full moon, but its light continues still the same. The first appearance of this phenomenon is generally in showers of falling rays, like those thrown from a rocket, although not so bright. These, being in constant and agitated motion, have the appearance of trickling down the sky. Large masses of light succeeded next in order, alternating from a faint glow, resembling the milky way, to the most vivid flashes, which stream and shoot in every direction with the effect of sheet lightning, except that after the flash the Aurora still continues to be seen.

The sudden glare and rapid bursts of these wondrous showers of fire render it impossible to observe them without fancying that they produce a rushing sound; but I am confident *there is no actual noise attending the changes, and that the idea is erroneous*. I frequently stood for hours together on the ice, to ascertain this fact, at a distance from any noise but my own breathing, and thus I formed my opinion.

Neither did I observe *any variety of color* in the flashes, which were to my eye always of the same shade as the milky way and vivid sheet lightning.

The stars which gleam through the Aurora certainly emit a milder ray, as if a curtain of the finest gauze were interposed.

It is remarkable that *whenever the weather is calm*, the Aurora has a tendency to form an arch at whatever position it may occupy in the heavens.

On the 29th of this month, we were particularly gratified by a beautiful exhibition of this kind at near midnight. A perfect arch was formed to the southward, stretching from east to west; its centre elevated about  $2^{\circ}$  above the horizon.

The night was serene and dark, which added considerably to its effect, and the appearance continued unchanged for about a quarter of an hour; *but, on a slight breeze springing up*, small rays shot occasionally to the zenith, and the arch became agitated with a gentle and undulating motion, after which it spread irregularly, and, separating into the usual streamers, soon diffused itself over the whole sky.

*In stormy weather*, the Northern Lights fly with the rapidity of lightning, and with a corresponding wildness to the gale which is blowing, giving an indescribable air of magic to the whole scene." —Lyon, pp. 99-101.

MAY 30, 1822.

"In the afternoon, a most singular phenomenon was observed in the heavens. The western sky was blue and cloudless, while overhead it was hazy, and abounding in what sailors call 'mackerel and mares' tails.' The division of colors was by a most perfect arch, the legs of which stood in the N. E. and S. W. A strong breeze from the westward did not in any way affect the edge of the bow, which was clearly defined.

With the legs stationary, the whole clouded part receded, or fell slowly to the eastward, in the same manner as the hood of a carriage is thrown back, until by degrees, and after the expiration of two hours, the sky was all of the same pure azure as had at first been seen in the west. A strong wind continued blowing all night."—Ibid., p. 204.

Winter Island.—Lat.  $66^{\circ} 11' 25''$  N. Long.  $83^{\circ} 10'$  W. November 15–16, 1821. PARRY.

"At thirty minutes past nine a. m. on the 15th, the weather being rather cloudy and a light breeze blowing from the southward, the electrometer was tried, and again at nine p. m. on the 16th, at which time the *Aurora Borealis*, consisting of a stationary white light near the horizon, was visible in the *S. by E.* quarter of the heavens; but in neither case was the gold-leaf in the slightest degree affected."—2 Parry, 133.

- N. B.—1. At 9h. 30m. a. m. electrometer tried, and again on the 16th at 9h. p. m.;  
 2. At which time *Aurora Borealis* was visible in the *S. by E.* quarter—stationary light;  
 3. But in neither case was the gold leaf affected.

NOVEMBER 17–18, 1821.

"At 8h. p. m. of the 17th, the *Aurora Borealis* was seen, consisting of a *stationary light* occupying a very small portion of the heavens in the *S. E. by E. quarter*, and close to the horizon, from which, at times, vivid flashes shot across the zenith nearly to the opposite horizon. After ten p. m., the stationary light shifted more to the southward, and then gradually disappeared. At ten p. m. on the 18th, this phenomenon assumed a similar appearance in the *S. by W.* quarter."—*Ibid.*, p. 133.

NOVEMBER 23–24, 1821.

"On the evening of the 23d, the *Aurora Borealis* made its appearance in the *northwest*, vivid coruscations shooting at times across the zenith to the opposite horizon. The gold leaf of the electrometer was not perceptibly affected by it.

On the morning of the 24th, it was again faintly seen in irregular streams of white light, extending from the *western horizon to the zenith*. For several hours the same night, also, this extraordinary phenomenon was visible from the *southeast, round by south, to west*, being principally confined to a space about five degrees above the horizon.

The magnetic needle, which was attentively watched, was not at all affected by any of these phenomena."—*Ibid.*, p. 135.

- N. B.—1. Gold leaf of electrometer not affected.  
 2. Magnetic needle not at all affected.

NOVEMBER 26–28, 1821.

"On the 26th, both in the morning and evening, the *Aurora* again appeared from *S. E. to S. W.*, the brightest part being about ten degrees above the horizon, and with pencils of rays shooting upwards towards the zenith. In almost every instance, it is observable that the light, however irregularly disposed in other respects, has a tendency to assume an arch-like form; but I think a plane bisecting the arch would more generally have coincided with the true than the magnetic meridian in the phenomena we had here an opportunity of observing. This was particularly the case on the morning of the 27th, when, at 6h. a. m., the *Aurora* formed one broad, continuous, and well-defined arch, its centre passing rather to the southward of the zenith, and its legs appearing to rest upon the horizon at east and west.

For several hours on the evening of the 28th, it was seen in the *S. E.* with rays darting rapidly up nearly as high as the zenith. There is almost always one stationary patch of light near the horizon, appearing, as it were, the source whence the shifting or variable part of the phenomenon proceeds.

It will be seen from about this period, how much more frequently the *Aurora* seemed to issue from the southeastern quarter than from any other during the rest of the winter."—*Ibid.*, p. 135.

- N. B.—1. Appeared from *S. W. to S. E.* (26th).  
 2. However irregularly disposed in other respects, has a tendency to assume an arch-like form.  
 3. Plane bisecting the arch generally coincided with the true meridian.  
 4. Evening of 28th, seen in *S. E.*  
 5. Almost always a stationary patch of light near the horizon.  
 6. From about this period, *Aurora* seemed to issue more frequently from *S. E.* quarter than from any other.

DECEMBER 2-3, 1891.

"The concluding month of this year presented more frequent as well as more brilliant displays of the Aurora Borealis than we had noticed at an earlier period of the winter.

On the evening of the 2d, we observed it constantly appearing, from five till ten o'clock, in one quarter of the heavens or another, but *entirely confined to the southern side of the zenith*. It consisted sometimes of luminous blotches or small clouds; at others, of coruscations shooting upwards, and a stationary light always perceptible near the horizon from *S. S. E. to S. W.* The light was white or yellowish-white, and the compass was not affected.

On the evening of the 3d, it also appeared in little white spots, *resembling the nebulae* in the heavens, as viewed by a telescope, or the milky way on a very clear night.

I may here remark, by the way, that this last beautiful feature of the heavens very seldom appeared here, for, notwithstanding the notion generally entertained of the *extreme clearness* of the atmosphere under a polar sky, *we have always found the very reverse to be the fact*. It is true, indeed, that, with a northerly or westerly wind, the sky was generally what *would be called clear*; but *there is scarcely one night in twenty* when the heavenly bodies, if viewed through a telescope, do not appear surrounded with more or less haze. Indeed, it very seldom happens that a considerable deposition of minute snow may not be observed to take place, even in the clearest nights, in these regions."—*Ibid.*, p. 141.

N. B.—1. Aurora entirely confined to the south side of the zenith.

2. Appeared in little white spots resembling the nebulae.

3. Instead of the extreme clearness of atmosphere under a polar sky, we have always found the very reverse to be the fact.

DECEMBER 4, 1891.

"While making lunar observations on the evening of the 4th, Mr. Ross and myself remarked a meteor falling from the S. E. to N. W., being about 40° high when it disappeared. It fell so slowly as to be visible for four or five seconds, but was in every other respect like the falling stars, as they are called, seen in other parts of the world.

At 11h. p. m., the Aurora was seen forming an arch, about 5° high in the centre and extending *from S. S. W. to S. E.* The magnetic needle of Alexander's compass was not perceptibly affected during its continuance."—*Ibid.*, p. 142.

DECEMBER 14, 1891.

"On the afternoon of the 14th, the Aurora began to show itself as soon as it was dark, consisting principally of rays shooting up from the horizon, *in the E. by N.*, towards the zenith, and sometimes passing through but very little beyond it towards the opposite side of the heavens. Just before ten o'clock, however, a much finer display of this phenomenon presented itself than we had yet seen this season.

There still remained a place near the horizon at *E. by N.*, whence a bright light seemed constantly to issue; and if any part of the phenomenon could be said to continue uniformly the same, it was the leg of a broadish arch in that point, which scarcely ever changed its place or the intensity of its light.

The arch was at times completed, or thrown over to the *W. S. W.*, being 15° high in the centre and generally about 2° broad, though in this respect it was irregular and somewhat variable. The lower part of the arch was always well defined, the space under it appearing dark, as if a black cloud had been there, which, however, was not the case, as we saw the stars in it unobscured except by the light of the *Aurora*. The upper side of the arch was never well defined, but its light was gradually softened off so as to mingle with the azure of the sky, and often sent up coruscations towards the zenith.

Thus far description may give some faint idea of this brilliant and extraordinary phenomenon, because its figure here maintained some degree of regularity; but during the most part of its continuance it is, I believe, almost impossible to convey to the minds of others an adequate conception of the truth. It is with much deference, therefore, that I offer the following descrip-

tion, the only recommendation of which, perhaps, is, that it was written immediately after witnessing this magnificent display.

Innumerable streams or bands of white and yellowish light appeared to occupy the greater part of the heavens *to the southward of the zenith, being much the brightest in the S. E. and E. S. E.*, from whence it had, indeed, often the appearance of emanating. Some of these streams of light were in right lines like rays; others crooked, and waving in all sorts of irregular figures and moving with inconceivable rapidity in various directions. Among these might frequently be observed those shorter collections or bundles of rays which, moving with even greater velocity than the rest, have acquired the name of the 'merry dancers,' which, if I understand aright the descriptions given of them by others, I do not think I ever saw before.

In a short time, the Aurora extended itself *over the zenith about half way down to the northern horizon, but no farther, as if there was something in that quarter of the heavens which it did not dare to approach.* About this time, however, some long streamers shot up from the horizon in the N. W., which soon disappeared.

While the light extended over part of the northern heavens, there were a number of rays assuming a circular or radiated form near the zenith, and appearing to have a common centre near that point, from which they all diverged. The light of which these were composed appeared to have inconceivably rapid motion in itself, though the form it assumed, and the station it occupied in the heavens, underwent little or no change for perhaps a minute or more.

Suppose, for instance, a stream of light to have occupied a space between any two of the stars, by which its position could be accurately noticed, the light appeared to pass constantly and instantaneously from one to the other, as if, when a portion of the subtle fluid of which it is composed had made its escape and vanished at the end next one of the stars, a fresh supply was uninterruptedly furnished at the other. This effect is a common one with the Aurora, and puts one in mind, as far as its motion alone is concerned, of a person holding a long ribbon by one end, and giving it an undulatory motion through its whole length, though its general position remains the same. One of the most striking of the various locomotive properties of the Aurora is that which it often has laterally, by which I mean in the direction perpendicular to its length. This motion, when compared with the other, is usually slow, though still very rapid in the 'merry dancers,' which seem to observe no law with regard to the rest of the phenomenon. When the streams or bands were crooked, the convolutions took place indifferently in all directions.

The Aurora did not continue long to the north of the zenith, but remained as high as that point for more than an hour; after which, on the moon rising, it became more and more faint, and at half past eleven was no longer visible. The color of the light was most frequently yellowish-white, sometimes greenish, and once or twice a lilac tinge was remarked when several strata, as it were, appeared to overlay each other by very rapidly meeting, in which case the light was always increased in intensity.

The *electrometer* was tried several times, and two of Kater's compasses exposed upon the ice during the continuance of this Aurora, but neither was perceptibly affected by it.

We listened attentively for any *noise* which might accompany it, *but could hear none*; but it was too cold to keep the ears uncovered very long at one time.

The intensity of the light was something greater than that of the moon in her quarters. Of its dimming the stars, there cannot, I think, be a doubt. We remarked it to be, in this respect, like drawing a gauze veil over the heavens in that part, the veil being most thick when two of the luminous sheets met and overlapped.

The phenomenon had all the appearance of being full as near as many of the clouds commonly seen, but there were none of the latter to compare them with at the time.

I may, in conclusion, remark that, notwithstanding the variety and changeableness displayed by this Aurora, there was throughout a perceptible inclination in the various parts of it to form an irregular arch from E. by N. over to S. W. by W."—*Ibid.*, pp. 142-144.

N. B.—1. Magnificent display.

2. Electrometer not affected.

3. Listened attentively, but could hear no noise.

4. Intensity of light greater than that of the moon in her quarters.

5. Aurora appeared to be fully as near as many of the clouds commonly seen.

## DECEMBER 20, 1821.

"From 7h. till 10h. p. m. on the 20th, while engaged in making observations upon the ice, we observed the *Aurora* almost constantly appearing, though varying in its form and situation. It commenced with a number of vertical coruscations from the *S. E.*, *S.*, and *N. W.* horizons, darting nearly as high as the zenith. This being discontinued after half an hour, the leg of an arch appeared at *E. S. E.* inclining towards the south, which remained nearly unaltered for three-quarters of an hour, its light being of a yellow cast and remarkably brilliant. After this an arch was gradually formed by the light extending over to *W. N. W.*, the brightest portion of it being still that in the eastern quarter. The arch was irregular, and sometimes not continuous, but divided into a number of luminous patches like *nebulae*.

We also noticed, and now remembered to have done so *once before*, that there were in some places narrow but long horizontal separations of the light, appearing like so many dark parallel streaks lying over it, which, however, they were not, as the stars were here most plainly visible.

The *magnetic needle* was not affected.

This night was one of the clearest we had during the winter, the milky way appearing unusually bright and well defined."—*Ibid.*, p. 144.

N. B.—1. From 7h. till 10h. p. m., *Aurora* constantly appearing.

2. Commenced with vertical coruscations from the *S. E.*, *S.*, and *N. W.* horizons.

3. Arch from *E. S. E.* to *W. N. W.*

4. The magnetic needle was not affected.

5. One of the clearest nights of the winter.

## DECEMBER 22, 1821.

"On the 22d, the electrometer was tried, the wind being light from the *N. W.*, with overcast weather, and some very small snow falling; but no perceptible effect was produced upon the gold leaf.

In the evening, the *Aurora* appeared like a white cloud in the *E. S. E.* At half past nine, an irregular arch extended from that point of the horizon to the *S. W.*, the breadth being from one to two degrees, though constantly varying, and its height in the middle ten degrees.

When this kind of arch appears most perfect, it is less frequently than any other kind attended with coruscations or very rapid motion in the light. When these do accompany it, they are almost invariably observed to proceed from the upper side of the arch only."—*Ibid.*, p. 145.

N. B.—1. Electrometer tried; no effect on the gold leaf.

2. *Aurora* appeared like a white cloud in the *S. E.*

## DECEMBER 23, 1821.

"In the evening of the 23d, though the wind was from the *N. W.*, a number of small roundish clouds, very unusual here at this season, rose from the *S. E.*, and the sky was very prettily illuminated in the intervals by the *Aurora*. These clouds remaining quite dark in their appearance, except about their edges, even during the most brilliant display of the *Aurora*, seemed to indicate that the latter phenomenon was the most distant of the two. The light of the *Aurora* was, as usual, much the brightest in the *S. E.* quarter.

This phenomenon again made its appearance very beautifully on the 24th, resembling, in most particulars, that described on the 14th. It was principally confined to the *southern half* of the heavens, and the streamers and coruscations, though almost infinitely varied, had an evident tendency to arch from *E.* by *S.* over to the opposite horizon.

The 'merry dancers' were also playing about with indescribable rapidity, and many of the sheets of light, when they overlapped in meeting, had a very perceptible lilac tinge."—*Ibid.*, p. 145.

## DECEMBER 28, 1821.

"On the morning of the 28th, the *Aurora Borealis* appeared faintly to the westward from four to six o'clock. Early on the following morning, it was observed to form an arch of very bright light from *S. E.* to *S. S. W.*, its centre being 30° high. In its general form it was quite stationary, as, indeed, the more perfect arches usually are, but varied occasionally in the intensity of the light and also in its continuity.

From the time that the daylight began to leave the heavens in the afternoon, the *Aurora* again appeared, commencing in the *S. E. by E.* with very long coruscations or streamers, which afterwards shot past the zenith over to the *N. W.*

At nine o'clock, the light had become concentrated into a low arch,  $4^{\circ}$  high in the centre, well defined at the lower edge, but not so at the upper. The legs were at first situated in the *E. S. E.* and *S. W. by W.* quarters, but the former gradually shifted about two points more to the south.

At one time in the evening, and before the phenomenon had assumed the more regular arch-like form above mentioned, we observed for the space of a few minutes together the same radiated appearance about the zenith as that described on the 14th. This changed pretty suddenly into an irregularly circular band of light, like a ribbon, and then again returned to the radiated form, but neither of these appearances continued very long. There was a great deal of lilac tint observable this evening, and the effect of the sheets of light in obscuring the stars was again too evident to admit a doubt.

The frequency and ill success with which we had tried the electrometer made us almost despair of ever detecting any electricity in the atmosphere, but on the evening of the 13th, the chain being observed to tremble very much, we thought the motion might have been occasioned by this cause. On applying the electrometer, however, the gold leaf was not in the slightest degree affected. We afterwards found it to have arisen from the wind acting upon the plank at the masthead in a certain angle, the same effect being once or twice afterwards produced with a breeze in the same direction."—*Ibid.*, pp. 145–146.

#### JANUARY 14, 1832.

"There was to-day a very thick deposit of snow almost constantly occurring, though the weather might very well be called clear. The winter atmosphere of these regions is, indeed, seldom or never free from it, as may readily be seen by placing an instrument in the open air for an hour or two. That of to-day only differed from the usual deposit in the degree in which it took place.

At one p. m., a thermometer on the north side of the post, on the ice, stood at  $-32^{\circ}$ , and the other, exposed to the sun's rays on the south side, only indicated a temperature one degree higher."—*Ibid.*, p. 153.

#### JANUARY 13, 1832.

"The appearances of the *Aurora Borealis* during January were generally more distinguished for their frequency than their brilliancy or for any extraordinary forms which this phenomenon presented.

Towards midnight on the 13th, the weather being clear, it appeared in a very bright arch from *S. to N. E.*, being  $10^{\circ}$  to  $15^{\circ}$  higher in the centre. It afterwards assumed a wavy or serpentine form, which constantly varied; and smaller streams of light seemed to be continually meeting the larger from near the zenith.

From midnight till 2h. a. m. (on the 14th), it continued very bright, and generally extended from east, where it was most brilliant, to *W. N. W.*"—*Ibid.*, p. 155.

#### JANUARY 15, 1832.

"The following evening [the 15th], an arch of the *Aurora* assumed the most perfect bridge-like form I ever saw. It extended from *S. E. to N. W.*, on the southern side of the heavens; both its edges being well defined, which is very rarely the case.

At 7h. a. m. on the following morning, it appeared again in a form still more novel, three complete *arcades* being now visible; the middle one, which was the brightest, passing through the zenith, and the others, which were in the centre, about  $30^{\circ}$  distant from it on each side, gradually closing till they joined it at the east and west points of the horizon.

It was impossible not to be struck with the general resemblance in the form of this phenomenon to that I have frequently mentioned as assumed by the clouds in the polar regions at particular seasons.<sup>1</sup> This coincidence may possibly serve to throw some light on the nature and peculiarities of the *Aurora*.

<sup>1</sup> Account of the Voyage of 1819–20, pp. 141, 144, 164.

For several hours on the same night, this meteor formed a tolerably well-defined arch from *E. S. E.* to *W. N. W.*, being  $6^{\circ}$  high in the centre, reaching from one horizon to the other, and confined entirely to the southern side of the heavens.

Early on the morning of the 16th, it was seen for an hour and a quarter much in the same situation, and on the following evening it appeared faintly in almost every part of the heavens."—*Ibid.*, pp. 155–56.

N. B.—Resemblance in form of Aurora; this coincidence may possibly serve to throw some light on the nature and peculiarities of the Aurora.

#### JANUARY 18, 1822.

"From 11h. p. m. till past midnight, on the 18th, it once more appeared very bright from *W.* to *S. E.*, having at times a very rapid and irregular motion. Whenever the light was most concentrated it was also the brightest, and almost always in that case we observed it to assume an arch-like form in the southern part of the heavens.

This was particularly the case on the evening of the 19th, when there appeared two concentric though not altogether continuous arches, extending from *S. E. by E.* to *W. S. W.*, the highest being  $8^{\circ}$  to  $10^{\circ}$  above the horizon, but in this respect at times slowly varying. At 11h. p. m., after thus remaining, without any very remarkable alteration, for above two hours, it suddenly became extremely variable, shifting its place *laterally* with a prodigiously rapid motion, but still keeping within the general limits above mentioned both in bearing and altitude. In this lateral motion, which was somewhat of the kind I have endeavored to describe on the 14th of December, it seemed, as it were, to roll over from one end of the arch to the other, while at the same time numberless lighter and less brilliant coruscations were emitted from its upper margin.

Whenever the phenomenon occupied the smallest space in the heavens, the light was invariably the most intense, and often when several sheets of it appeared to unite, in the manner before explained, the lilac tint was quite vivid; in general its color was yellowish. Stars of the second magnitude were almost obscured by it.

Towards the end of January, this phenomenon appeared frequently in the *S. E.* and *E. S. E.*, but it was generally faint, and unmarked by any peculiarity requiring further notice.

The electrometer was frequently applied to the mast-head chain, and the magnetic needle constantly watched during all these appearances, but neither of these was on any one occasion sensibly affected."—*Ibid.*, pp. 156–57.

#### MARCH, 1822.

"The appearance of the Aurora Borealis was less frequent during March than in the preceding winter months, in consequence of the increased duration of daylight at this period. Whatever slight variations might exist in these appearances, it still continued a matter of constant remark to us, that the phenomenon almost invariably commenced in the *southeastern* quarter of the heavens; and it is perhaps worthy of notice, that the same thing was observed by Crantz in Greenland (whose very words would truly describe what we so frequently noticed during this winter).

The arch-like form assumed by the Aurora was also one of its almost invariable peculiarities; the legs of the arch being usually situated somewhere between the east and west points of the horizon, and almost always occupying the *southern side* of the heavens.

The only instance of this phenomenon during the month of March deserving particular description, occurred on the evening of the 30th, when it made its appearance as usual in the *southeastern* horizon, from whence it soon diffused itself in a low but tolerably regular arch extending to the *W. S. W.* Again, at times, it altogether vanished, and then as suddenly reappeared much in the same situation as before.

We often fancied that this phenomenon exhibited a light of greater actual intensity when the moon was above the horizon than at other times, though its appearance was of course less splendid on that account. Whether this was in reality the case or not, we had no means of correctly judging; but some idea of its brightness may be formed from the circumstance of its being very often distinctly visible when the moon was between her quarters and the full.

The electrometer was tried during the continuance of this evening's Aurora, but no effect was perceptible either on that or a Kater's compass."—*Ibid.*, p. 200.

APRIL 4, 1822.

"The phenomenon frequently observed at Melville Island in the spring, of the white *clouds* assuming the form of two continuous arches with their legs meeting near the east and west horizons, was finely displayed on the 4th; the height of the arches in the centre, from the north and south horizons, being from  $50^{\circ}$  to  $70^{\circ}$ ."—*Ibid.*, p. 206.

APRIL 16, 1822.

"Some hard, well-defined clouds, being nearly the first we had seen this season, appeared for a short time to-day, and were welcomed as the harbingers of returning moisture in the atmosphere. The Aurora Borealis was seen at night to the southward, and extending at times in a broad band of light across the heavens, but at a low altitude, from east to west."—*Ibid.*, p. 213.

MAY 2, 1822.

"After sunset on the evening of the 2d, a thin horizontal streak or band of vapor appeared along the lower parts of the land. As the night advanced, it became thicker and more diffused, and at length, for the first time this season, the ships were for an hour or two enveloped in fog."—*Ibid.*, p. 228.

MAY 16, 1822.

"On the evening of the 16th, something like small rain was falling for a few minutes, being the first we had seen this season; but it soon formed the less equivocal form of sleet, the thermometer being at  $81^{\circ}$ ."—*Ibid.*, p. 228.

JUNE 2, 1822.

"On the 2d, at 8h. p. m., a thin white *cloud* was observed to extend across the northern sky from northeast to southwest, being then about  $65^{\circ}$  high in the centre. The whole of the heavens to the southward of this was covered with a *similar kind of cloud*, that to the northward exhibiting a clear blue sky. The edge, which was well defined, formed a very perfect arch, and here the *cloud* was much more dense than in any other place, reminding one of a veil of gauze of which there were more folds in that part than elsewhere. Though the wind was, with us, at W. by N., it blew gently over to the S. S. E., still retaining its perfect and continuous arch-like form at the margin. In a quarter of an hour, it had got  $20^{\circ}$  on the south side of the zenith, in forty minutes was only  $25^{\circ}$  high, and in an hour and a quarter had totally disappeared beneath the southern horizon, leaving the whole of the heavens perfectly cloudless.

This was the most striking phenomenon of the kind we had ever witnessed, and, while the arch remained near the zenith, this magnificent canopy had a singularly grand and imposing appearance."—*Ibid.*, p. 238.

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Duckett's Cove.—Lat.  $66^{\circ} 12' 36''$  N. Long.  $86^{\circ} 44' 45''$  W. August 29, 1821. PARRY.

"The morning was beautifully clear and tranquil, and the Aurora Borealis was faintly visible at break of day in the *southwest quarter of the heavens*."—1 Parry, 69.

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Chamisso Island.—Lat.  $66^{\circ} 13' 11''$  N. Long.  $161^{\circ} 47' 45''$  W. Sept. 28, 1827. BEECHY.

"On the 24th and 28th, the nights were clear and frosty, and the Aurora Borealis was seen forming several arches.

On the 28th, the display was very brilliant and interesting, as it had every appearance of being *between the clouds and the earth*; and, after one of these displays, several meteors were observed issuing from parts of the arch, and falling obliquely towards the earth.



This was also one of the rare instances of the Aurora being seen to the southward of our zenith."  
—2 Beechey, 560.

N. B.—1. Had every appearance of being between the clouds and the earth.

2. This was one of the rare instances of the Aurora being seen to the southward of our zenith.

At Sea.—Lat.  $66^{\circ} 40'$  N. Long.  $59^{\circ}$  W. September 23, 1818. ROBERTSON.

"About ten in the evening, the Aurora Borealis was seen in the true south horizon. The horizon was first illuminated like the rising or setting of the moon behind a cloud, or rather like the illumination of the atmosphere caused by great fires. This extended four points of bearings. Rays were soon after darted up perpendicularly in bundles to  $20^{\circ}$  altitude. The Aurora spread to S. E. without darting rays, and soon after disappeared."—1 John Ross (Lieut. Robertson), App. 120.

Behring's Sea.—Lat.  $66^{\circ} 30'$  N., Long.  $168^{\circ} 00'$  W., to Lat.  $71^{\circ} 23' 31''$  N., Long.  $156^{\circ} 21' 30''$  W. Autumns of 1826 and 1827. BEECHER.

"We had frequent opportunities of observing the Aurora Borealis in the Autumns of 1826 and of 1827. From the 25th of August until the 9th of October, about the time of the departure of the Blossom from the northern regions in both years, this beautiful meteor was visible on every night that was clear, or when the clouds were thin and elevated. [In 1826 it was visible on twenty-one nights; in 1827 only eleven.] It is remarkable that, in both years, its first appearance was on the 25th August. The season of 1826 was distinguished by an almost uninterrupted succession of fine weather and easterly winds, and that of the following year by continued boisterous weather and winds from the westward. In the former year, the weather being fine, the Aurora was more frequently seen than in the latter; but in 1827 the displays were brighter, and the light more frequently passed to the southward of the zenith. It never appeared in wet weather.

In 1826, when, as before mentioned, the weather was settled, the Aurora generally began in the W. N. W. and passed over to the N. E. until a certain period, after which it as regularly commenced in the N. E. and passed to the N. W.; whilst in 1827, the appearance of the meteor was as uncertain as the season was boisterous and changeable.

The period when this change in the course of the light took place, coincided very nearly with that of the equinox; and, as the Aurora Borealis has been supposed to be affected by that occurrence, we imagined that the change might be in some way owing thereto; but the irregularity of the meteor in this respect, in 1827, gave a contradiction to this hypothesis. It was, however, uniform in making its appearance *always in the northern hemisphere*, and generally in the form of elliptical arches from  $3^{\circ}$  to  $7^{\circ}$  of altitude, nearly parallel with the magnetic equator.

These arches were formed by short perpendicular rays passing from one quarter to the other with a lateral motion, or by their being met by similar rays from the opposite direction. The arches, when formed, in general remained nearly stationary, and gave out coruscations which streamed towards the zenith. When at rest, the light was colorless; but when any movement took place, it exhibited prismatic colors, which increased in strength as the motion became rapid. The coruscations seldom reached our zenith, and more rarely passed to the southward of it, but when that occurred the display was always brilliant; on one occasion only they extended to the southern horizon.

We remarked that when any material change was about to occur one extremity of the arch became illuminated, and that this light passed along the belt, with a tremulous hesitating movement, toward the opposite end, exhibiting the colors of the rainbow. An idea may be formed of this appearance, from the examination of the rays of some molluscons animals in motion, such as the nereis, but more particularly the beroes. Captain Parry has compared its motion to the waving

of a ribbon. As the light proceeded along the arch, coruscations emanated from it; and, as the motion became violent, the curve was often deflected and sometimes broken into segments, which were brightest at their extremities and in general highly colored. When one ray of the Aurora crossed another, the point of intersection was sometimes marked by a prismatic spot, very similar to that which occurs in the intersections of coronæ about the moon, but far more brilliant; and when the segments, which generally *crooked* towards the zenith, were much curved, colors were perceptible in the bend. Generally speaking, after any brilliant display, the sky became overcast with a dense haze or with light fleecy clouds.

The Aurora has been frequently observed to rest upon a *dark nebulous substance*, which some persons have supposed to be merely an optical deception, occasioned by the lustre of the arch; but this appearance never occurs above the arch, which would be the case, I think, if these surmises were well founded. We sometimes saw this *cloud* before any light was visible, and observed it afterwards become illuminated at its upper surface, and exhibit all the appearances above mentioned.

It was the general opinion that the lustre of all the stars *was diminished* by the Aurora, but particularly by this part of it.

Captain Parry, however, observes that the stars in this dark cloud were unobscured, except by the light of the Aurora. He, however, agrees with us in the lower part of the arch being always well defined, and the upper being softened off, and gradually mingled with the azure of the sky. It is worthy of notice, that we never observed any rays shoot downwards from this arch, and I believe the remark will apply equally to the observations of Captains Parry and Franklin."—2 Beechey, 2, 722.

- N. B.—1. In 1826, Aurora generally began in the W. N. W. and passed over to the N. E.  
 2. After a certain period, it as regularly began in the N. E. and passed over to N. W.  
 3. Whilst in 1827 the appearance of it was uncertain.  
 4. It was, however, uniform in making its appearance always in the northern hemisphere.  
 5. It was frequently observed to rest upon a dark nebulous cloud.  
 6. We sometimes saw the cloud before any light was visible.  
 7. The lustre of all the stars was diminished by the Aurora.

"We frequently observed the Aurora attended by a thin, *fleecy, cloud-like substance*, which, if not part of the meteor, furnishes a proof of the displays having taken place within the region of our atmosphere, as the light was decidedly seen between it and the earth. This was particularly noticed on the 28th of September, 1827. The Aurora on that night began by forming two arches from W. by N. northward to E. by N., and about eleven o'clock threw out brilliant coruscations. Shortly after, the zenith was obscured by a lucid haze, which soon condensed into a canopy of light clouds. We could detect the Aurora above this canopy by several bright arches being refracted, and by brilliant colors being apparent in the interstices.

Shortly afterwards the meteor descended, and exhibited a splendid appearance, without any interruption from clouds, and then retired, leaving the fleecy stratum only visible as at first. This occurred several times, and left no doubt in my own mind of the Aurora being at one time above and at another below the canopy formed about our zenith.

I must not omit to observe here that, on several occasions when the light thus intervened between the earth and the cloud, brilliant meteors were precipitated obliquely toward the south and southwest horizons."—Ibid., p. 723.

- N. B.—1. Aurora frequently attended by a fleecy cloud-like substance;  
 2. Which proves that its displays were within the region of our atmosphere,  
 3. As the light was decidedly between it and the earth.  
 4. Aurora at one time above and at another time below a canopy formed about our zenith.  
 5. On several occasions, when the light intervened between the earth and the clouds, brilliant meteors were precipitated.

"This supposition of the light being *at no great elevation*, is strengthened by the different appearance exhibited by the Aurora at the same times to observers not more than from ten to thirty miles apart, and also by its being *visible to persons on board the ship at Chamisso Island after it*

*had vanished in Escholts Bay, only ten miles distant, as well as by the Aurora being seen by the barge detached from the Blossom several days before it was visible to persons on board the ship about two hundred miles to the southward of her.*—Ibid., p. 723.

N. B.—1. Aurora at no great elevation.

2. Visible to persons on board the ship after it had vanished in Escholts Bay, only ten miles distant.

"In Kotzebue's Sound [lat.  $66^{\circ} 30' N.$ , long.  $163^{\circ} W.$ ], the Aurora was seldom visible before ten o'clock at night or after two o'clock in the morning.

*We never heard any noise, nor detected any disturbance of the magnetic needle; but here I must observe that Kater's compass was the only instrument employed for this purpose, and then on board the ship only, the exposed situation in which we were anchored not admitting of any establishment on shore, either for this purpose or for astronomical observations.*—Ibid., p. 724.

"In considering the subject of the Aurora Borealis, my attention was drawn to a fact which does not appear to me to have been hitherto noticed. I allude to the direction in which the Aurora generally makes its first appearance, or, which is the same thing, the quarter in which the arch formed by this meteor is usually seen. It is remarkable that in this country the Aurora has always been seen to the northward; by the expeditions which have wintered in the ice, it was almost always seen to the southward; and by the Blossom, in Kotzebue's Sound, 250 miles to the southward of the ice, it was, as in England, always observed in a northern direction. Coupling this with the relative positions of the margins of the packed ice, and with the fact of the Aurora appearing more brilliantly to vessels passing near the situation of that body than by others entered far within it—as would seem to be the case from the reports of the Greenland ships, and from my own observations at Melville Island and at Kotzebue's Sound—it does appear, at first sight, that that region is most favorable to the production of the meteor."—Ibid., p. 725.

N. B.—1. In Kotzebue's Sound, Aurora seldom visible before 10h. p. m. or after 2h. a. m.

2. Never heard any noise,

3. Nor detected any disturbance of the magnetic needle.

4. Here the Aurora has always been seen to the northward.

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Fort Hope (Repulse Bay).—Lat.  $66^{\circ} 32' 16'' N.$  Long.  $86^{\circ} 55' 51'' W.$  Aug. 15, 1846. RAE.

"This was a beautiful day throughout. In the evening, the sky being clear and cloudless, some stars were visible, and a few streaks of orange-colored Aurora showed themselves to the southward."—Rae, p. 65.

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Fort Hope (Repulse Bay).—Lat.  $66^{\circ} 32' N.$  Long.  $86^{\circ} 56' W.$  Sept., 1846, to April, 1847.

From Dr. RAE's Meteorological Register.

SEPTEMBER, 1846.

"23d. Aurora visible to the southward at 8h. p. m.

OCTOBER, 1846.

16th. Faint Aurora to the S. and S. by E.; altitude  $12^{\circ}$ .

17th. Much drift. Aurora to S. S. E., parallel to the horizon; altitude  $12^{\circ}$ .

18th. Drift; cirrus. Some faint streaks of Aurora to the west.

21st. Much drift. At 8h. p. m., several streaks of faint Aurora extending across the zenith in a N. W. and S. E. direction; many rays in different parts of the heavens.

27th. Some faint streaks of Aurora in various parts of the sky, bearing for the most part N. N. W. and S. S. E.

28th. A few clouds near horizon; a very faint, light-yellow cloud Aurora to the S. E. and N. W.

29th. Cirrus extending from S. S. E. to N. N. W., resembling much the Aurora.

## NOVEMBER, 1846.

- 5th. Drifting. A faint ray of Aurora to the S. E. extending vertically towards the zenith.
- 6th. Drifting. Some faint beams of Aurora extending from S. W. to N. W.; altitude  $60^{\circ}$ . One ray to the S. E. pointing towards the zenith.
- 14th. Much drift. A faint beam of Aurora to the westward, directed towards the zenith; drifting.
- 17th. Drifting. Three beams of Aurora pointing towards the zenith; two of them bearing N. N. W., and the other S. E.
- 20th. At 7h. 30m., a faint Aurora extending from W. to S. E.; altitude  $20^{\circ}$ ; motion rapid, no prismatic colors.
- 22d. Some faint streaks of Aurora, most of them to the southeastward and pointed towards the horizon.
- 23d. Some faint rays of Aurora visible this morning at 5h. 30m. in different parts of the heavens; drifting.
- 25th. Two faint beams of Aurora bearing W. N. W. and pointing towards the zenith; altitude of lower limb  $30^{\circ}$ .

## DECEMBER, 1846.

- 6th. Parhelia with prismatic colors. Aurora visible to the south in two arches arising from near the horizon to the zenith.
- 13th. The sky to the north had a beautiful lake-colored tint at sunset; the most brilliant display of Aurora I have observed this winter, the centre being towards the true south, and gradually rising from an altitude of  $12^{\circ}$  to  $70^{\circ}$  or  $80^{\circ}$ . It was of a pale yellowish-green color. Horizontal needle not affected.
- 14th. Some faint beams of Aurora in different parts of the heavens. A very faint Aurora to the southward.
- 15th. A very faint Aurora; centre true south.
- 17th. Wind variable from N. to E. Faint Aurora to the S.; altitude  $10^{\circ}$ ; centre S. S. W.  $30^{\circ}$ .
- 18th. Aurora faint to the S. by W.
- 21st. Arch of Aurora across zenith nearly east and west; brightest at western extremity.

## JANUARY, 1847.

- 2d. Faint Aurora; centre S. W. by S.; altitude  $15^{\circ}$ . Drifting. Some streaks of Aurora to the southward pointing to the zenith.
- 3d. A beam of Aurora to the south pointing to the zenith.
- 4th. Aurora faint; centre of arch S. by W.; altitude  $10^{\circ}$ . Aurora in a narrow line parallel to horizon; altitude  $4^{\circ}$ ; extent  $70^{\circ}$ ; centre south.
- 6th. Drifting. A faint Aurora extending from S. S. E. across the zenith.
- 11th. Much drift. A beam of Aurora S. E.; altitude  $25^{\circ}$ .
- 12th. Much drift. Very faint Aurora; centre W. by N.; altitude  $10^{\circ}$ .
- 13th. Drifting. A very faint Aurora; centre S. S. W.; altitude  $16^{\circ}$ ; extent  $60^{\circ}$  or  $70^{\circ}$ .
- 14th. Drift. Arch of Aurora faint; altitude  $11^{\circ}$ ; centre S. S. W.; extent  $90^{\circ}$ .
- 16th. Drifting, stratus. Arch of Aurora faint; centre south; altitude  $18^{\circ}$ ; extent  $60^{\circ}$ . Centre S. S. W.; altitude  $12^{\circ}$ ; extent  $90^{\circ}$ .
- 17th. Drifting. Aurora visible, faint but brightest to the westward; centre south; altitude  $60^{\circ}$ .
- 18th. A very faint arch of Aurora from N. W. by N. extending across zenith.
- 26th. A faint arch of Aurora across zenith S. W. and N. E.
- 28th. Drifting; very cold to the sensation; spiculae of snow falling. A broad band of Aurora, the lower edge having a reddish or lake tint, running parallel to the horizon; altitude  $2^{\circ}$ ; centre S. W.; extent  $70^{\circ}$ . Some beams of Aurora S. E. pointing towards the zenith.

## FEBRUARY, 1847.

- 9th. Drifting; solar halo with parhelia. A faint arch of Aurora.
- 10th. Cirrus. Some faint beams of Aurora S. and S. S. W. (say S. W.).

APRIL, 1847.

3d. At 8 p. m., a faint Aurora of an orange color; centre south; altitude  $5^{\circ}$ .—Ree, pp. 225-239.

"On the 3d of April, the thermometer rose above zero for the first time since the 12th of December. As the Aurora was seldom noticed after this date, I may here make a few remarks on this subject. It was often visible during the winter, and usually made its appearance first to the southward in the form of a faint yellow or straw-colored arch, which gradually rose up towards the zenith. During our stay at Fort Hope, I never witnessed a finer display of this strange phenomenon than I had done at York Factory, nor did it on any occasion affect the horizontal needle as I had seen it do during the previous winter there.

The Esquimaux, like the Indians, assert that the Aurora produces a distinctly audible sound, and the generality of Orkney men and Zetlanders maintain the same opinion, although, for my own part, I cannot say that I ever heard any sound from it.

A fine display, particularly if the movements are rapid, is very often succeeded by stormy or snowy weather, but I have never been able to trace any coincidence between the direction of its motions and that of the wind."—Ibid., p. 96.

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Cape Espenberg (Behring's Sea).—Lat.  $66^{\circ} 34' 56''$  N. Long.  $163^{\circ} 36' 38''$  W. Sept. 22, 1826. BEECHY.

"On the 22d, the Aurora Borealis was seen in the W. N. W., from which quarter it passed rapidly to the N. E. and formed a splendid arch emitting vivid and brilliantly colored coruscations."—Beechey, 1, p. 329.

SEPTEMBER 25, 1826.

"During the night we had a brilliant display of the Aurora Borealis, remarkable for its masses of bright light. It extended from N. E. to W., and at one time formed three arches."—Ibid., p. 330.

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Fort Confidence.—Lat.  $66^{\circ} 53' 36''$  N. Long.  $118^{\circ} 48' 45''$  W. April, 1838. SIMPSON.

"Now that the constant daylight renders the Aurora Borealis no longer visible, I shall make one or two general remarks regarding it. Its most common appearance at Fort Confidence is an arch with little motion, passing through the zenith and spanning the heavens from *northwest to southeast*. Now, since the variation of the compass here little more than four points easterly, it follows that there is a tendency in this remarkable phenomenon to dispose itself at *right angles to the magnetic meridian*.

In the depth of winter, thin white clouds, seen during the short imperfect daylight, in many instances proved to be the Aurora; which, also, not unfrequently appeared through a hazy sky. Its displays were seldom very brilliant, and it hardly ever exhibited those vivid prismatic tints which I had often admired in lower latitudes."—Simpson, p. 237.

"On the 24th of April, the thermometer rose at noon to the freezing point, for the first time since the 17th of October; a period of six months and a week! The mean temperature for the whole of that long and dismal interval is  $14^{\circ}$  below zero."—Ibid., 236.

MARCH 5, 1839.

"This season, as I have already remarked, was less severe than its predecessor; and, as if it were a consequence of the difference, the Aurora was more brilliant, displaying on several occasions the prismatic hues; but the same arched form *from northwest to southeast* predominated. Every clear night, when not eclipsed by the moon, it was to be seen, but was *brightest and most active in the mornings* some time before daylight.

At a quarter to four a. m., on the 5th of March, Ritch witnessed a most brilliant exhibition. It formed a quadrant issuing from W. N. W. and extending to the zenith. There it doubled on

itself, and terminated in a semi-elliptical figure, apparently very near the earth, in rapid motion, and tinged with red, purple, and green. The half ellipse seemed to descend and ascend, accompanied by an *audible sound, resembling the rustling of silk*. This lasted for about ten minutes, when the whole phenomenon suddenly rose upwards and its splendor was gone.

Ritch is an intelligent and credible person, and, on questioning him closely, he assured me that he had perfectly distinguished the sound of the Aurora from that produced by the congelation of his breath—for the temperature at the time was  $44^{\circ}$  below zero.

I can, therefore, no longer entertain any doubt of a fact uniformly asserted by the natives, and insisted on by Hearne, by my friend Mr. Dease, and by many of the oldest residents in the fur countries; though I have not had the good fortune to hear it myself."—*Ibid.*, p. 330.

**Fort Macpherson, on Peel's River.—Lat.  $67^{\circ}$  N. Long.  $185^{\circ}$  W. Sept. 1849. HOOPER.**

"6th. At 0.30 a. m., witnessed an appearance of the Aurora, a broad blaze of light passing from east, through the zenith, to west; rays uncolored; slight horizontal coruscations and tremors in rapid movement, with occasional light airs from S. E.

7th. At midnight of yesterday, we observed an appearance of the Aurora different in its style to any I have ever before seen. It formed an arc from  $5^{\circ}$  in elevation at N. E. to about  $10^{\circ}$  at E. N. E., and presented much the same form and appearance as a lunar rainbow, but did not possess prismatic colors; its hue being grass-green, with vertical light purple rays or stripes, which were not constant. It fringed a heavy 'nimbus,' imparting to it a shade of ultramarine, in which the rolling folds or waves of the cloud were finely marked. It being tolerably close to the moon (rather below and to the eastward of her), I at first imagined it to be a lunar rainbow; she was, however, much obscured, and I am nearly of a decided opinion that it was not such, but an Aurora.

12th. A very mild day; the evening clear and calm. At 11.30 p. m., saw a faint Aurora extending in an arch from S. W. to S. S. W.; centre about  $10^{\circ}$  altitude; main color pale green, with a few vertical purple rays.

16th. Ten p. m., observed Aurora extending in an arch from S. S. W. to W. by N.; central altitude about  $30^{\circ}$ .

17th. One a. m., a very beautiful Aurora extending right round the visible horizon in regular vertical rays, extending to, and converging in, the zenith. The weather calm, very fine, and clear. At midnight, a faint Aurora, not having any precise tending, being dispersed in irregular lines all over the heavens.

19th. From about 8 p. m. until midnight, there was a fine display of the Aurora, which appeared in a succession of fretted waves or folds, constantly swaying and shifting about with the light variable airs occasionally springing up."—Hooper's Journal, pp. 148, 151, 152.

**Cape Krusenstern.—Lat.  $67^{\circ} 8'$  N. Long.  $163^{\circ} 46'$  W. August 25, 1827. BEECHY.**

"For the first time since we entered Behring's Straits, the night was clear, and the Aurora Borealis sweeping across the heavens, reminded us that it was exactly on that night twelvemonth that we saw this beautiful phenomenon for the first time in these seas. A short time before it began, a brilliant meteor fell in the western quarter. The Aurora is at all times an object of interest, and seldom appears without some display worthy of admiration, though the expectation is seldom completely gratified. The uncertainty of its movements, and of the moment it may break out into splendor, has, however, the effect of keeping the attention continually on the alert; many of us, in consequence, stayed up to a late hour, but nothing was exhibited on this occasion more than we had already repeatedly witnessed.

We were more fortunate the following night, when the Aurora approached nearer the southern horizon than it had done on any former occasion that we had observed in this part of the globe.

It commenced much in the usual manner, by forming an arch from *W. N. W.* to *E. N. E.* and then soared rapidly to the zenith, where the streams of light rolled into each other, and exhibited brilliant colors of purple, pink, and green. It then became diffused over the sky generally, leaving about  $8^{\circ}$  of clear space between it and the northern and southern horizons.

From this tranquil state it again poured out coruscations from all parts, which shot up to the zenith and formed a splendid cone of rays, blending pink, purple, and green colors in all their varieties. This singular and beautiful exhibition lasted only a few minutes, and then the light became diffused over the sky in a bright haze."—Beechey, 2, 588-89.

**Fort Good Hope.**—Lat.  $67^{\circ} 28' 21''$  N. Long.  $130^{\circ} 54' 38''$  W. September, 1849. HOOPER.

"27th. At night we observed a fine Aurora spreading all over the sky, and having very little movement."—Hooper's Journal, p. 153.

**At Sea.**—Lat.  $68^{\circ} 19' 45''$  N. Long.  $66^{\circ} 5' 45''$  W. September 12, 1820. PARRY.

"Soon after 10h. p. m., the Aurora Borealis made its appearance. I am indebted to Captain Sabine for the following description of this phenomenon:—

"The Aurora was visible for upwards of half an hour, its appearance being comprised within about twelve points of the heavens from *S. E. by E. to W. by N.*, the magnetic north being about  $N. 76^{\circ} W.$

The character of this phenomenon was peculiar, being distinguished from those which we were accustomed to see at Melville Island, by the far greater rapidity with which it spread and shifted from one part of the heavens to another; by the depth and vividness of the colors, both of red and green, with which its coruscations were tinted; and by its streamers breaking out unexpectedly in places previously obscure, and extending indifferently downwards as well as upwards. The latter distinction was contrasted with the more usual appearance of rays streaming towards the zenith from an arch of faintly brilliant light.'

An Aurora of similar appearance was observed in the Atlantic during the return of the *Isabella*, in October, 1818, from Davis's Strait to Shetland. The peculiarities of the present phenomenon were more marked in the commencement than towards the conclusion of its appearance."—1 Parry, 291-2.

**At Sea.**—Lat.  $68^{\circ} 19'$  N. Long.  $60^{\circ} 5'$  W. September 13, 1820. FISHER.

"The Aurora was seen last night streaming very beautifully from *west to southeast*; in the latter direction its motions were very rapid, and its colors were also very brilliant. The prevailing color was a light yellow; but the outer edge of those coruscations, that streamed towards the zenith, appeared at different times of a light purple hue."—Fisher, p. 285.

**Behring's Sea.**—Lat.  $68^{\circ} 30'$  N. Long.  $167^{\circ} W.$  August 25, 1826. BEECHY.

"The night of the 25th was clear and cold, with about four hours' darkness, during which we beheld a brilliant display of the Aurora Borealis, which was the first time that phenomenon had been exhibited to us in this part of the world. It first appeared in an arch extending from *W. by N.* to *N. E. magnetic* (by the north).

The arch, shortly after it was formed, broke up; but united again, threw out a few coruscations, and then entirely disappeared. Soon after, a new display began in the direction of the western foot of the first arch, preceded by a bright flame, from which emanated coruscations of a pale straw color. An almost simultaneous movement occurred at both extremities of the arch, until a

complete segment was formed of waving perpendicular radii. As soon as the arch was complete, the light became greatly increased; and the prismatic colors, which had before been faint, now shone forth in a very brilliant manner. The strongest colors, which were also the outside ones, were pink and green; the centre color was yellow, and the intermediate ones, on the pink side, purple and green, on the green side purple and pink; all of which were as imperceptibly blended as in the rainbow. The green was the color nearest the zenith. This magnificent display lasted a few minutes, and the light had nearly vanished, when the S. E. quarter sent forth a vigorous display, and nearly at the same time a corresponding coruscation emanated from the opposite extremity. The western foot of the arch then disengaged itself from the horizon, crooked to the northward, and the whole retired to the N. E. quarter, where a white spot blazed for a moment, and all was darkness.

I have been thus particular in my description, because the appearance was unusually brilliant, and because very few observations on this phenomenon have been made in this part of the world.

There was no noise audible during any part of our observations, nor were the compasses perceptibly affected."—Beechey, 1, 281-82.

- N. B.—1. There was no noise audible during any part of our observations,  
2. Nor were our compasses perceptibly affected.

Nijnei Kolymak.—Lat.  $68^{\circ} 31' 53''$  N. Long.  $160^{\circ} 56'$  E. November 22, 1820. VON WRANGELL.

"The polar night had set in on the 22d of November (1820), and the beauty of the varied forms of the Aurora, seen on the deep azure of the clear northern sky, was a source of unwearied enjoyment to us almost every evening."—Von Wrangell, p. 83.

Nijnei Kolymak.—Lat.  $68^{\circ} 31' 53''$  N. Long.  $160^{\circ} 56'$  E. 1820-21. VON WRANGELL.

"The general characteristics of the Aurora Borealis are so well known that it is unnecessary to describe them here; I will, therefore, confine myself to the following particulars, which appear to deserve a special notice.

1. When the streamers rise high, and approach the full moon, a luminous circle of from  $20^{\circ}$  to  $30^{\circ}$  is frequently formed round it; the circle continues for a time and then disappears.
2. When the streamers extend to the zenith, or nearly so, they sometimes resolve themselves into small, faintly luminous, and cloud-like patches, of a milk-white color, and which not unfrequently continue to be visible on the following day in the shape of *white wave-like clouds*.
3. We often saw on the northern horizon, below the auroral light, dark blue clouds, which bear a great resemblance in color and form to the vapors which usually rise from a sudden break in the ice of the sea.
4. Even during the most brilliant Auroras, we could never perceive any considerable noise, but in such cases we did hear a slight hissing sound, as when the wind blows on a flame.
5. The Auroras seen from Nijnei Kolymak (lat.  $68^{\circ} 32'$ ) usually commence in the northeastern quarter of the heavens; and the middle of the space which they occupy in the northern horizon is generally  $10^{\circ}$  or  $20^{\circ}$  east of true north. The magnetic variation at this place is about  $10^{\circ}$  east.
6. Auroras are more frequent and more brilliant on the sea-coast than at a distance from it. The latitude of the place does not otherwise influence them. Thus, for example, it would seem from the accounts of the Tobuktebes, that in Koliutchin Island (in  $67^{\circ} 26'$  latitude), Auroras are much more frequent and more brilliant than at Nijnei Kolymak, in latitude  $68^{\circ} 32'$ . On the coast, we often saw the streamers shoot up to the zenith; whereas this was rarely the case at Nijnei Kolymak; nor was the light nearly so brilliant at the latter place.
7. The inhabitants of the coast affirm, that after a brilliant Aurora they always have a strong gale from the quarter in which it appeared; we did not observe this to be the case at Nijnei



Kolymak. The difference, however, may proceed from local circumstances, which often either prevent the sea-winds from reaching so far inland, or alter their direction. For example, it often happens that there is a strong northerly wind at Pochodak, seventy wersts north of Kolymak, while at the latter place the wind is southerly.

8. The finest Auroras always appear at the *beginning of strong gales* in November and January; when the cold is most intense, they are more rare.

9. A remarkable phenomenon which I often witnessed deserves to be recorded; i. e., when shooting stars fell near the lower portion of an auroral arch, fresh kindled streamers instantly appeared, and shot up from the spot where the star fell.

From some of the above remarks, it may be inferred that the freezing of the sea may be connected with the appearance of Auroras. Perhaps a great quantity of electricity may be produced by the suddenly rising vapors, or by the friction of large masses of ice against each other.

The Aurora does not always occupy the higher regions of the atmosphere; it is usually nearer the surface of the earth, and this is shown by the visible influence of the lower current of the atmosphere on the beams of the Aurora. *We have frequently seen the effect of the wind on the streamers as obvious as it is on clouds; and it is almost always the wind which is blowing at the surface of the earth.*—Von Wrangell, p. 506.

N. B.—1. We have frequently seen the effect of the wind on the streamers as obvious as it is on the clouds;

2. And it is almost always the wind that is blowing on the surface of the earth.

"There is a remarkable phenomenon known here by the name of *Teplai Weter* (the warm wind), blowing from the S. E. by S. It sometimes begins suddenly, when the sky is quite clear, and in the middle of winter raises the temperature, in a short time, from  $-47^{\circ}$  to  $+25^{\circ}$ ; so that the plates of ice which are the substitute for glass in the windows begin to melt. In the valleys of the Aniui, the warm wind is frequently felt; its influence does not extend to the west of Cape Tchukotski. It is seldom of longer continuance than twenty-four hours."—*Ibid.*, p. 49.

"*Northeast wind*, or more often E. N. E., is seldom of long continuance and violent. It usually clears the atmosphere from mist, and thus causes the thermometer to rise in summer and to fall in winter. *Auroras often accompany this wind in winter.*

*Southeast wind* drives away mist, and may be regarded as the prevailing wind in autumn and winter. Sometimes, in the middle of winter, a wind from the S. E. by E., or S. E.  $\frac{1}{2}$  E., causes the temperature to rise suddenly from  $-24^{\circ}$  to  $+25^{\circ}$ , or even to  $32^{\circ}$ ; previously to this, the barometer sinks as much as four-tenths of an inch in the course of eight hours. The S. S. E. wind has no particular influence either on the barometer or thermometer. S. E. winds, but more particularly E. by S. and E. winds, are frequently accompanied by Auroras."—*Ibid.*, p. 518.

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Nijnei Kolymak.—Lat.  $68^{\circ} 31' 53''$  N. Long.  $160^{\circ} 56'$  E. March 1, 1821. COCHRANE.

"The only meteorological phenomenon which occurred during my stay at the Kolyma, was the Aurora Borealis. The scene fell far short of my expectations. I understood, however, that the months of October and November are the most proper to view them in their greatest splendor.

Those which appeared during my stay were generally from the north, and consisted of columns of fire moving in an horizontal direction, and generally disappearing in the southwest; the height of the columns being from  $50^{\circ}$  to  $60^{\circ}$ .

At times, an immense illuminated space from north to east would advance very close to us, and throwing up rays or rockets of fire, and, forming into concave arches, approached us so near as apparently to endanger our situation, exhibiting at the same time every color of the rainbow.

The most beautiful Aurora which I saw was at midnight of the 1st of March, 1821. The wind was from the N. N. W., and the glass at  $36^{\circ}$  of cold. The Aurora occupied the whole circle of the heavens, at an elevation of  $23^{\circ}$  or  $30^{\circ}$ , and, gradually rising, disappeared in the zenith. The figure was as an illuminated tent, with festoons or fringes at the lower part, and which had

an appearance as if constantly receiving accessions of fire, which were equally distributed to it from every part of the foundation of the tent. The illuminated part gradually diminished in splendor as it approached the zenith.

It lasted about two hours, and did a little affect the electrometer."—Cochrane, p. 184.

**Virohni Kovima.**—Winter of 1786–87. BILLINGS.

"The effects of the cold are wonderful. Upon coming out of a warm room, it is absolutely necessary to breathe through a handkerchief; and you find yourself immediately surrounded by an atmosphere, arising from breath and the heat of the body, which incloses you in a mist, and consists of small nodules of hoar ice. Breathing causes a noise like the tearing of coarse paper or the breaking of thin twigs, and the expired breath is immediately condensed in the fine substance mentioned above.

The Northern Lights are constant and very brilliant; they seem close to you, and you may sometimes hear them shoot along; they assume an amazing diversity of shapes; and the Tungoose say that they are spirits at variance fighting in the air."—Sauer (Billings), p. 57.

**Hearne's Sea, north of Coppermine.**—Lat.  $68^{\circ} 48' 27''$  N. Long.  $115^{\circ} 31'$  W. September 9–16, 1889. SIMPSON.

"Stress of weather sadly retarded our return. The last of the Canada and snow geese quitted the shores of the Polar Sea, and our deer hunters' excursions were fruitless, the animals having already made a move inland.

One night there was a most *superb display of the Aurora without the prismatic tints*; and on another, that was pitch dark, the flashing of the sea almost rivalled that strange lustre of the heavens. We pursued our way unremittingly night and day, fair and foul, whenever the winds permitted; and on the 16th, in a bitter frost, and the surrounding country covered with snow, we made our entrance into the Coppermine, after by far the longest voyage ever performed in boats on the Polar Sea, the distance we had gone not being less than 1,408 geographical, or 1,631 statute miles."—Simpson, p. 388.

**Igloolik.**—Lat.  $69^{\circ} 15'$  N. Long.  $81^{\circ} 45'$  W. 1822–23. PARRY.

NOVEMBER 7, 1822.

"The appearances of the Aurora Borealis were neither frequent nor brilliant during this month.

On the 7th, near midnight, this phenomenon appeared from *E. S. E. to S. W.*, forming an irregular arch of white light, not continuous in every part, and about  $8^{\circ}$  high in the centre. From the upper margin of this arch, comets now and then shot upwards towards the zenith."—2 Parry, 381.

NOVEMBER 21, 1822.

"On the morning of the 21st, Mr. Ross remarked a bright arch of the Aurora passing *through the zenith from east to west*, and meeting the horizon at each end. Besides this, two smaller, and apparently concentric arches, were visible to the southward; the higher arch being in the centre about twenty degrees above the horizon, and the other about ten degrees.

An arch of the same kind appeared at night in the *southwest* quarter of the heavens."—Ibid., p. 381.

DECEMBER 13, 1822.

"Between one and two a. m. on the 13th, while Messrs. Ross and Bushnan were employed in taking some observations alongside the Fury, they saw a vivid flash of light, which it afterwards occurred to them must have come down the electric chain attached to the masthead, directly under which they happened to be standing at the time.

As soon as Mr. Fisher was acquainted with this circumstance, he applied the electrometer to the chain, but, as usual, without any perceptible effect on the gold leaf.

The Aurora Borealis had been visible to the *southward* for some hours during the night, but had disappeared for half an hour before the flash was seen."—*Ibid.*, p. 386.

#### FEBRUARY 15, 1823.

"On the 15th, some remarkable *clouds* were hanging over the open water to the eastward, appearing like vast volumes of smoke curling into rounded and almost circular forms. This peculiarity we never observed at any other time, though there was constantly a 'water-sky' in that direction, consisting of a general and diffused darkness, varied occasionally by numerous vertical columns of 'frost smoke.'"—*Ibid.*, p. 407.

N. B.—1. Remarkable clouds hanging over the open water to the eastward.

2. Constantly a water-sky in that direction.

#### MARCH, 1823.

"At the close of the month of March, we were glad to find that its mean temperature, being  $-19.75^{\circ}$ , when taken in conjunction with those of January and February, appeared to constitute a mild winter for this latitude. There were, besides, some other circumstances which served to distinguish this winter from any preceding one we had passed in the ice. One of the most remarkable of these was the frequent occurrence of *hard and well-defined clouds*; a feature we had hitherto considered as almost unknown in the winter sky of the polar regions.

It is not improbable that these may have in part owed their origin to a large extent of sea keeping open to the southeastward throughout the winter, though they not only occurred with the wind from that quarter, but also with the colder weather usually accompanying northwesterly breezes."

—*Ibid.*, p. 418.

N. B.—Hard and well-defined clouds were of frequent occurrence; a feature hitherto considered as almost unknown in the polar regions.

"Another peculiarity observed in this winter was the *rare occurrence* of the Aurora Borealis, and the *extraordinary poorness* of its display whenever it did make its appearance.

It was almost invariably seen to the *southward*, between an *E. S. E.* and a *W. S. W.* bearing, generally low, the stationary patches of it having a tendency to form an irregular arch, and not unfrequently with coruscations shooting towards the zenith. When more diffused, it still kept, in general on the *southern side* of the zenith; but never exhibited any of those rapid and complicated movements observed in the course of the preceding winter, nor, indeed, any feature that renders it necessary to attempt a particular description.

The *electrometer* was frequently tried by Mr. Fisher, at times when the state of the atmosphere appeared the most favorable, but *always without any sensible effect being produced on the gold leaf.*"—*Ibid.*, p. 420.

N. B.—1. Another peculiarity observed in this winter was the rare occurrence of the Aurora Borealis, and the poorness of its display.

2. It was almost invariably seen to the southward.

3. Electrometer frequently tried,

4. But always without any effect on the gold leaf.

#### Igloulfik.—Lat. $69^{\circ} 15'$ N. Long. $81^{\circ} 45'$ W. March, 1823. LYON.

"During the dark season, I mean the time that we did not at all see the sun, it was remarked with astonishment that the Aurora Borealis was very rarely seen, in fact only once or twice, and then so faintly as scarcely to call our attention."—Lyon (Private Journal), p. 306.

#### At Sea (Davis's Strait).—Lat. $69^{\circ} 30'$ N. September, 1825. PARRY.

"In running down Davis's Strait, as well as in crossing the Atlantic, we saw on this passage, as well as in all former autumnal ones, a good deal of the Aurora Borealis.

It first began to display itself on the 15th of September, about the latitude of  $69\frac{1}{2}^{\circ}$ , appearing in the (true) *southeast* quarter as a bright luminous patch five or six degrees above the horizon, almost stationary for two or three hours together, but frequently altering its intensity, and occasionally sending up vivid streamers towards the zenith.

It appeared in the same manner, on several subsequent nights, in the *southwest*, west, and east quarters of the heavens; and on the 20th, a bright arch of it passed across the zenith from *southeast* to northwest, appearing to be *very close to the ship*, and affording so strong a light as to throw the shadow of objects on the deck."—S Parry, 170.

N. B.—Very close to the ship.

On the Ice.—Lat.  $69^{\circ} 48' N.$  Long.  $168^{\circ} 4' E.$  March 1, 1821. VON WRANGELL.

"The thermometer was at  $-25^{\circ}$  throughout the day.

In this day's journey we saw an unusual phenomenon: in the *N. E. horizon* there appeared an insulated dark-gray cloud, from which white beams streamed to the zenith and across it to the opposite horizon, resembling the beams of the Aurora, but whether luminous or not we could not tell on account of the daylight. The phenomenon lasted about half an hour. One of our Cossacks who had been before on the Polar Sea, maintained that the cloud was occasioned by vapor rising from a sudden crack in the ice.

On the same evening, there was an Aurora extending from *N. E. to N. W.*"—Von Wrangell, pp. 101-2.

N. B.—Preceded by a dark-gray cloud with beams streaming from it to the zenith.

On the Ice.—Lat.  $69^{\circ} 58' N.$   $168^{\circ} 41' E.$  March 2, 1821. VON WRANGELL.

"We saw this evening an Aurora of extraordinary beauty. The sky was clear and cloudless, and the stars sparkled in their fullest arctic brilliancy. With a slight breeze from the *N. E.*, there rose in the *E. N. E.* a great column of light, from which rays extended over the sky, in the direction of the wind, in broad and brilliant bands, which appeared to approach us, whilst they varied continually in form.

From the rapidity with which the rays shot through the whole space from the horizon to the zenith, in less than two seconds, the Aurora appeared to be *nearer to us than the ordinary height of the clouds*. We could perceive no effect on the compass needle."—Von Wrangell, pp. 103-4.

N. R.—1. Aurora nearer than the ordinary height of clouds.

2. No effect on the compass needle.

Felix Harbor (Gulf of Boothia).—Lat.  $69^{\circ} 59' N.$  Long.  $92^{\circ} 1' 6'' W.$  Ross.

OCTOBER 18, 1829.

"It was a beautiful day, with calm weather; the thermometer was between  $6^{\circ}$  and  $8^{\circ}$ , but in the evening it fell till it reached  $1^{\circ}$  only, at seven o'clock. This was by very much the lowest temperature we had yet experienced. Sunday found all our men well, and him who had met with the accident recovered. More than fifty lunar distances were obtained for the longitude. The Aurora was seen in the southeast."—S Ross, 204.

OCTOBER 21.

"The Krusenstern was secured yesterday, and at night an Aurora made its appearance."—*Ibid.*, p. 205.

OCTOBER 31.

"At sunset there was a large halo, being but the second we had seen; it was, however, only a white one. There was afterwards an Aurora to the southward."—*Ibid.*, p. 208.

## NOVEMBER 1.

"There was an Aurora at night, but not brilliant."—*Ibid.*, p. 216.

## NOVEMBER 21.

"A very faint Aurora was seen in the southeastern horizon."—*Ibid.*, p. 223.

## NOVEMBER 24, 25.

"There was a brilliant Aurora to the southwest, extending its red radiance as far as the zenith. The wind vacillated on the following day, and there was a still more brilliant one in the evening, increasing in splendor till midnight, and persisting till the following morning. It constituted a bright arch, the extremities of which seemed to rest on two opposed hills, while its color was that of the full moon, and itself seemed not less luminous; though the dark and somewhat blue sky by which it was backed was a chief cause, I have no doubt, of the splendor of its effect.

We can conjecture what the appearance of Saturn's ring must be to the inhabitants of that planet; but here the conjecture was perhaps verified, so exactly was the form and light of this arch what we must conceive of that splendid planetary appendage when seen crossing the Saturnian heavens. It varied, however, at length, so much as to affect this fancied resemblance; yet with an increase of brilliancy and interest. While the mass, or density, of the luminous matter was such as to obscure the constellation Taurus, it proceeded to send forth rays in groups, forming such angular points as are represented in the stars of jewelry, and illuminating the objects on land by their coruscations. Two bright nebulae of the same matter afterwards appeared beneath the arch, sending forth similar rays, and forming a still stronger contrast with the dark sky near the horizon. About one o'clock it began to break up into fragments and nebulae; the coruscations becoming more frequent and irregular until it suddenly vanished at four."—*Ibid.*, p. 223-4.

## DECEMBER 2.

"A black cloud in the southern horizon would have prevented the sun from being seen, though it had still risen above that line, as it did the day before. The magnetic observatory was erected, and the other one commenced. At midnight there was a magnificent arch of an Aurora, but it was only five degrees high. The color was a light yellow, and it emitted rays; finally breaking up and disappearing about one o'clock."—*Ibid.*, p. 227.

## DECEMBER 9.

"The temperature fell to 26° minus in the evening, and there was an insignificant Aurora."—*Ibid.*, p. 228.

## DECEMBER 18.

"There was another beautiful Aurora this day."—*Ibid.*, p. 229.

## DECEMBER 19.

"Clouds obscured the Aurora of yesterday, though it was still partially visible, as if occupying the whole space from east to west."—*Ibid.*, p. 229.

## DECEMBER 20.

"The Aurora still continued; and, in want of other variety, it afforded us amusement amid this wearisome uniformity.

After the Aurora had ceased, it recommenced at night in a more brilliant form, with bright flashes amid its other varieties, disappearing a little after midnight. The clearness of the sky overhead was such, that we could see perfectly well in the cabin at midday, even through the double skylight, though it was covered with snow. Outside the ship, the smallest print could be read distinctly."—*Ibid.*, p. 230.

## DECEMBER 24.

"There was again an Aurora; another to add to a succession of these appearances more regular and durable than any which had been experienced in the former voyage to this climate."—*Ibid.*, p. 231.

## DECEMBER 25.

"It was Christmas day. There are few places on the civilized earth in which that day is not, perhaps, the most noted of the year; to all, it is at least a holiday, and there are many to whom it was somewhat more. The elements themselves seemed to have determined it should be a noted day to us, for it commenced with a most beautiful and splendid Aurora, occupying the whole vault above. At first, and for many hours, it displayed a succession of arches, gradually increasing in altitude as they advanced from the east and proceeded towards the western side of the horizon; while the succession of changes were not less brilliant than any that we had formerly witnessed."—*Ibid.*, p. 231.

## DECEMBER 30.

"There was very good light during the day from ten till half after three, and, in the course of it, the temperature rose to minus 20°. There was also a faint Aurora; and some transits of the stars were observed."—*Ibid.*, p. 232.

## DECEMBER 31.

"On the Aurora Borealis which we had so often seen, no experiments could be made, from the state of the weather, and the force of the winds, at those times." *Ibid.*, p. 234.

## JANUARY 6, 1830.

"Another obscure Aurora made its appearance in the zenith."—*Ibid.*, p. 241.

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 Sheriff Harbor (Gulf of Boothia).—Lat. 70° N. Long. 91° 53' W. Ross.

## JANUARY, 1831.

"There were many gales, as the Journal has shown; and on all those days the barometer fell and the temperature rose. But it was an invariable remark that, when the gale was from the northward, the former fell less, and the thermometer rose more, than when it was from any other quarter; as this was also most striking when the wind was from the southward. The Auroras were very inconspicuous; but the halos were of a very striking character."—2 Ross, 503.

## FEBRUARY 7, 8.

"The cold weather continued through the two following days, in which there was nothing remarkable but a slight Aurora."—*Ibid.*, p. 504.

## MARCH 1.

"There was a bright Aurora, which agitated the magnetic needle in the manner that has been often observed. Such light as I could collect from it by means of a large reading lens, had no effect on the differential thermometer."—*Ibid.*, p. 506.

## MARCH 9.

"Sunday (March 6) was somewhat warmer, the temperature rising in the day to 28° for two hours. It was 40° on Monday night, and a hare was killed on that day. The two following days (8th and 9th) were little noticeable for anything but a general continuance of the same weather and temperature; except that, on the last of those, there was a bright Aurora."—*Ibid.*, p. 506.

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 Baffin's Bay.—Lat. 70° 03' 33" N. [Long. 68° 20' W.] April 6, 1851. KANE.

"At 1 a. m., faint and fleeting Aurora visible to the S. E. At 9 p. m., an Aurora to the south (true)."—1 Kane, p. 530.

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 Sheriff's Bay (850 feet north of Felix Harbor).—Lat. 70° 1' N. Long. 91° 54' W. Ross.  
 NOVEMBER 14, 1830.

"A bright Aurora Borealis was the only noticeable event. They had been rare or absent for a long time."—2 Ross, 485.

DECEMBER 16, 1830.

"There was little to note this day but a splendid Aurora."—*Ibid.*, p. 494.

JANUARY, 1831.

"The Auroras were very inconspicuous; but the halos were of a very striking character."—*Ibid.*, p. 503.

FEBRUARY, 1831.

"7th and 8th. There was nothing remarkable but a slight Aurora."—*Ibid.*, p. 504.

MARCH, 1831.

"1st. There was a bright Aurora.

2d. There was a bright Aurora."—*Ibid.*, p. 506.

"As the expedition which I commanded in 1818 did not winter in the arctic regions, my observations during that voyage were confined to the months of September and October, during which time the ships were moving in a southerly direction from the latitude of  $74^{\circ}$  to  $58^{\circ}$  N.; when it was observed that from the latitude of  $74^{\circ}$  until  $66^{\circ}$  the phenomenon was seen to the *southward*, particularly at midnight; but that when the ship had passed to the southward of the latitude of  $66^{\circ}$ , it was seen to the *northward*. In several instances, the Aurora was distinctly observed to be between the two ships, and also between the ships and the icebergs; proving unquestionably that it could not be at that time beyond the atmosphere of the earth. This, indeed, was the only fact which I completely established during that voyage."—2 Ross, Appendix, pp. 118–14.

Victoria Harbor (Gulf of Boothia).—Lat.  $70^{\circ} 09' N.$  Long.  $91^{\circ} 34' W.$  Jan. 8, 1832. Ross.

"The thermometer came down to  $45^{\circ}$ , but, being calm, it was not very cold. It is certain, also, that we had now resumed our winter standard of sensation on this subject. The Aurora was again seen on Saturday (the 8th)."—2 Ross, p. 624.

On the Ice.—Lat.  $70^{\circ} 20' N.$  Long.  $174^{\circ} 13' E.$  March 21, 1823. VON WRANGELL.

"I availed myself of the unavoidable delay to take a meridian altitude, which gave our latitude  $70^{\circ} 20'$ ; the longitude, deduced by angles from points visible on the mainland, was  $174^{\circ} 13'$ , the variation  $21\frac{1}{2} E.$

We profited by the light of a beautiful Aurora in the *northeast quarter* to continue our march until the night was far advanced, when we had accomplished twenty-four wersts since noon, among old hummocks and loose snow, which afforded comparatively easy travelling."—Von Wrangell, p. 332.

"The winter of 1822–23 was generally considered a very mild one at Nijnei Kolymak. The temperature was only once as low as  $-51^{\circ}$  (on the 10th of January), and Auroras were rare, and not so brilliant as usual."—*Ibid.*, p. 318.

N. B.—Winter mild. Auroras rare; not brilliant.

Baffin's Bay.—Lat.  $70^{\circ} 43' 56'' N.$  Long.  $63^{\circ} 44' 33'' W.$  KANE.

"March 26, 1851. At 11 p. m., faint Aurora to southward and eastward.

March 28. At 11 p. m., Aurora to the eastward (true)."—1 Kane, 529.

Middle Ice of Baffin's Bay.—Lat.  $71^{\circ} 20' N.$  Long.  $62^{\circ} 28' W.$  Sept. 21, 1852. INGLESFIELD.

"A calm, lovely night, with brilliant Aurora and starlit sky, gave symptoms of fine weather, which,

in our present position, was much to be desired, although a little wind would be beneficial to keep the ice sufficiently in motion to prevent our being frozen in."—Inglesfield, p. 98.

**Moore's Harbor, Point Barrow.**—Lat.  $71^{\circ} 23'$  N. Long.  $156^{\circ} 29'$  W. Winter of 1853–54.

"Compared with the last year, the winter set in with great severity; the ship being frozen in ten days sooner, and the temperature falling below zero on the 28th of September, sixteen days earlier than in the previous season. This winter was altogether colder than the last, with a considerable less fall of snow, and the sky generally clearer; but there is some reason to consider it nearer the mean climate of the place.

Associated with this was a more frequent display of Aurora Borealis, suggesting the idea of this phenomenon being connected with terrestrial radiation."—Maguire's Report.

**Baffin's Bay.**—[Lat.  $72^{\circ} 10' 11''$  N. Long.  $68^{\circ} 36' 40''$  W.] February, 1851. KANE.

"19th. At 5 a. m., an Aurora visible, passing near the zenith, in a N. N. W. and S. S. E. direction.  
21st. At 1 a. m., a faint Aurora to the east. At 4 p. m., an Aurora passing through the zenith, and extending to the horizon in a N. W. and S. E. direction (true).

24th. At 6 a. m., a faint Aurora seen about the zenith in a southward and westward direction.

25th. At 3 p. m., faint Aurora visible, passing through the zenith in a N. W. and S. E. direction. At 10 p. m., several Auroras seen to the northward and westward.

26th. At 1 a. m., an Aurora to the southward and eastward. At 9 p. m., several Auroras visible in different parts of the heavens.

27th. At 3 a. m., Aurora passing through the zenith in an east and west direction."—1 Kane, p. 527.

**Baffin's Bay.**—[Lat.  $72^{\circ} 15'$  N. Long.  $68^{\circ} 40' 22''$  W.] February 12, 1851. KANE.

"A fine, pleasant day. At 7 p. m., faint Aurora visible to the southward (true)."—1 Kane, p. 526.

**Baffin's Bay.**—Lat.  $72^{\circ} 19' 40''$  N. Long.  $68^{\circ} 55' 20''$  W. February 7, 1851. KANE.

"I have quoted the 'fog or cloud-like segment' as forming a prominent feature in the continental descriptions, for the purpose of introducing from my Journal two anomalous exhibitions of Aurora in the same connection. One was in direct conjunction with the diffracted solar rays; the other, a true daylight Aurora. I give them verbatim from my notes.

'February 7. Cold and clear; thermometer, at 8h. 40m. a. m., at  $38^{\circ}$ , while on the vessel's stern, and at  $42^{\circ}$  when freely suspended by the bows outside; my Green's spirit standard, some fifty paces from the vessel, at  $-48^{\circ}$ : one more illustration of the local influence of ship-board, and of the irregularity of our system of registration.

The sun was completely visible at about ten a. m., but his rays were subdued by a slight haziness, caused by myriads of crystallized specks that filled the atmosphere. These, when examined by my travelling Fraunhofer at two hundred diameters, gave in some few cases regular hexagonal prisms, with well-defined terminations; but this symmetry of form was generally obscured by groupings and long oblique truncations. I have now made eight careful examinations of these crystalline spiculae, at varying temperatures, when they come to us accompanied by parhelia, halos, or anomalous columns proceeding from the sun. In every case, there was a decided approach to the six-sided form.

The sun to-day exhibited an unusual phenomenon. At 10h. 20m., while very low, a column of light was observed stretching from the upper summit of its disk to an approximate height of  $15^{\circ}$ . This expanded fan-fashion as it rose, and was lost by its pencilled radiations blending with the illuminated sky. Thus far it did not differ materially from the vertical or crepuscular rays accompanying rudimentary forms of parhelia. But, by eleven o'clock, this fan-like column had enlarged to a cloudy shaft of bright yellow light, twenty to twenty-four degrees in height, and proceeding from a complete segment of illumination, which was thickly studded with



cirrous clouds. The upper terminus of this column, unlike the parhelia which we had seen before, assumed a curvilinear wedge shape, not unlike the section of a pear, from whose sides rose tangentially a series of pencilled illuminations terminating in streaks of cloud strata.

The feature about this phenomenon of greatest interest, was a distinct play of light, a series of coruscating changes resembling the scintillations of the Aurora. The rays which shot out from the three-curved summit sometimes extended twelve or fifteen degrees, with a sudden movement of increased energy almost resembling ignition; then, again, they retired, until represented by but a few feeble points. The cloud-like segments showed in a lesser degree the same movements; and, at the periods of most active display, the vertical or fan-like shaft flashed up into more intense illumination. The diameter of this shaft at its entering base could not have been less than eighty degrees.

This singular exhibition recalled irresistibly the analogous phenomena of the Aurora, with those anomalous displays of coronæ which have been referred to diffraction of light by atmospheric vesicles or icy spicules. I give it from my notes as a simple detail of facts, without comment or opinion.

A daylight Aurora has been described by other observers. I witnessed several, one of them interesting enough to be worth transcribing.

About ten o'clock, going out to exercise at foot-ball, I noticed that the usual cloud-bank of the horizon had nearly cleared away at the south. One or two feathery cirri hung about the zenith, and the northern horizon retained its usual deep obscurity. This was in the course of my usual cursory examination for my weather record. Half an hour after, I observed one spot where the banking remained, attracting attention by its nearness to the sun and its well-defined segmentary character. Its margin was distinctly and regularly arched; its tinting a peculiar purple, slightly warmed or bronzed at its margins, but deepening into a heavy brown at the line of the horizon. The centre of the segment bore south twenty degrees west (magnetic); its altitude eight degrees nearly. Smoke and vapor from ship's fires purple tinted; distant objects not very clearly visible; atmosphere filled with ice spicules.

Soon from the circumference of this arch proceeded a fimbriated or fringy series of purple cirri, delicately tinted at their edges, increasing with wonderful regularity, and extending in long, ray-like processes of cloud to an altitude of some twenty degrees above the horizon. Before eleven o'clock, these processes had become long, stratiform, illuminated clouds, beautifully marked, of a breadth, measured roughly by the eye, of four or five degrees, interrupted where they crossed the illuminated region of the sun, but everywhere else extending over the heavens to the south and west (true); and, although still diminishing in intensity, extending nearly to the eastern quarter of the sky. By coalescing at their bases, these radiating processes augmented the size of the central segment. The intervals between them appeared, by contrast, to be artificially illuminated. Till now there had been no movement; but, at 11h. 20m., these cloud-like processes or radiations strikingly resembled the rays or beams of a coruscating Auroral arch. Dr. Vreeland and myself witnessed repeatedly interruptions of their continuity; then suddenly shootings out, or increasings of their length; and then a rapid and momentary formation, followed by a sudden and complete disappearance.

At this time, too, a strange wavy movement was seen about the shorter prolongations in the neighborhood of the vertex of the mass. These resembled the rising wreaths of 'frost-smoke' seen in the Wellington Channel, and had an appearance almost of combustion.

During all these phases, the cloud-like character was singularly preserved; the rays appeared to modify the processes as light would behind our ordinary clouds. The whole exhibition was a daylight one, perfectly cloud-like, differing only in the elements of shape, movement, and radiated illumination. It was a day Aurora.

The appearance continued until twenty minutes of meridian. At 11h. 10m., when it was at its maximum, the rayed prolongations stretched nearly across the sky; and the centre of the mass from which they emanated was fifteen degrees west from the south pole of the needle. At about the same deviation—viz: N. by E.  $\frac{1}{2}$  E.—and at a rude altitude of about fifteen or twenty degrees, was an irregular cirro-cumulated cloud of the same purple tint, but not so much illu-

minated. From its eastern margin, rays or processes were seen stretching as high as fifty degrees, and as far as due east.

Before the sun had reached his meridian altitude, the prolongations had become faint, and passed into detached feathery clouds, when collected at the zenith and lost the radiated arrangement altogether. The mass of cloud stratus to the south (magnetic), also, had blended with the usual bank about the horizon.'—1 Kane, pp. 819-828.

**Baffin's Bay.**—[Lat.  $72^{\circ} 30'$  N. Long.  $69^{\circ}$  W.] February, 1851. KANE.

"2d. 1 a. m., Aurora visible to the southward and eastward (true); beams of light covering the whole of the eastern half of the heavens, most of them parallel to the plane of the meridian. Aurora extending to within  $80^{\circ}$  of the horizon to the N. W."—1 Kane, p. 526.

"Between the hours of six and eight p. m., we had an interesting display of the Aurora. It was of a luminous white, not much more marked than any of the isolated nebulae seen through a telescope, which it indeed resembled. This white light stretched in cumulated masses from the northwest to the southeastern horizon, forming to the northward an arch of some regularity. From the inner circumference of this great arch proceeded a series of scintillating processes, at apparent right angles to the plane of the horizon, and constantly shifting their positions, so as to produce an effect nearly like that of the 'merry dancers.' To the south, however, the arch became irregular and changing; its diameter varied from five to thirty degrees, the augmentation being a broken series of parallel bands, no one exceeding six or eight degrees.

At the period of its greatest intensity, 7h. 10m., it enveloped Procyon and the Pleiades, obscuring the larger portion of Taurus, and actually hiding Aldebaran. A process extended obliquely from about twelve degrees above the horizon to Castor and Pollux, whose brightness it sensibly dimmed. The zone then narrowed, passing about eleven degrees to the west of Polaris, and ascending in a regular arch to the northwest. It faded gradually, and by 9h. 20m. had disappeared.

Neither a silk-suspended magnetic needle, nor our rude electrometers, detected any disturbance.—Ibid., p. 816.

"5th. Faint Aurora seen to the southward and eastward.

6th. 7 a. m., a faint Aurora to the southward, near the horizon.

7th. 2 a. m., faint Aurora seen to N. N. E. and S. S. W. 7. a. m., Aurora to the S. E. and E. (true).—Ibid., p. 526.

**Somerset House, Prince Regent's Inlet.**—Lat.  $72^{\circ} 48'$  N. Long.  $95^{\circ} 41'$  W. ROSS.

DECEMBER, 1832.

"The Aurora Borealis had been seen but seldom, and was inconspicuous, while its position was generally opposed to that of the sun. But, to end with the summary of this month, the weather, variable and severe as it had been, became calm and clear, though cold; and thus did we terminate the month of December, and the year 1832."—2 Ross, 688.

MARCH, 1833.

"We had taken but three foxes and two hares in the whole month; which, as food, amounted to nothing. At the end of it, after all the changes had taken place under the gales, the ice was so rough that it was impassable on sledges, and even on foot. No Aurora Borealis had been seen; and, indeed, we had scarcely noticed one the whole winter."—Ibid., p. 694.

**Baffin's Bay.**—Lat.  $72^{\circ} 49' 15''$  N. Long.  $70^{\circ} 59' 15''$  W. January 29, 1851. KANE.

"6 a. m., faint Aurora near the horizon. One-third of the sun's disk visible from the deck. 11 p. m., faint Aurora near the horizon, to the S. W. and N."—1 Kane, p. 525.

**Baffin's Bay.**—Lat.  $72^{\circ} 52' 45''$  N. Long.  $71^{\circ} 15' 35''$  W. January 28, 1851. KANE.

"1 a. m., light Aurora from W. to S. W. Two arcs of light, the southern being about  $10^{\circ}$ , the western  $20^{\circ}$  from the horizon at the middle point. About two-thirds of the sun's disk visible from the topgallant yard."—1 Kane, p. 525.

**Baffin's Bay.**—Lat.  $73^{\circ} 09' 18''$  N. Long.  $72^{\circ} 02' 21''$  W. January, 1851. KANE.

"26th. Aurora visible to the northward, 9 p. m.

27th. Auroras to the southward and westward, near the horizon, 2 a. m. and 8 a. m."—1 Kane, p. 525.

**Port Bowen.**—Lat.  $73^{\circ} 18' 39''$  N. Long.  $88^{\circ} 54' 49''$  W. October, 1824—March, 1825. PARRY.

"The Aurora Borealis, which constitutes one of the peculiar features of a polar winter, occurred with nearly the same frequency as on former occasions. The number of nights on which it is registered are—

|                |                 |
|----------------|-----------------|
| 2 in October,  | 15 in January,  |
| 5 in November, | 13 in February, |
| 7 in December, | 5 in March;     |

being, in the whole, forty-seven from October to March.

It may have appeared faintly on a few other occasions, not noticed in our Journals, and unquestionably would have been seen more frequently but for the height of the land on the south side of Port Bowen, which intercepted our view to the altitude of five or six degrees.

By far the greater part of these phenomena assumed one general character, and occupied nearly the same position.

It usually consisted of an arch, sometimes tolerably continuous, but more frequently broken into detached irregular masses or nebulae of light, extending from about W. to S. E. (true); which bearings correspond with N. E. by N. and W. by S. (magnetic).

It sometimes, however, extended a few points beyond these bearings, but very rarely occupied any of the northern part of the heavens.

Its termination to the S. E. was never exactly visible, owing to the height of land in that quarter; but, upon the whole, the arch seems to have been more frequently bisected by the plane of the magnetic, than by that of the true meridian.

The altitude of the upper margin of a permanent arch seldom exceeded ten or fifteen degrees, and from this coruscations were generally observed to be shooting towards the zenith.

In a few instances, the arch itself passed as high as the zenith; and on a single occasion, on the 28th of January, its direction was from true north to south.

The lower edge of the arch was generally well defined and unbroken, and the sky beneath it appeared, by contrast, so exactly like a dark cloud (to me often of a brownish color) that nothing at the time of viewing it could well convince one to the contrary, if the stars shining there with undiminished lustre did not discover the deception."—3 Parry, 59.

N. B.—1. Number of nights on which Aurora was seen.

2. The greater part assumed the same general character.

3. Usually consisted of an arch extending from W. to S. E.

4. Coruscations seldom occupied any of the northern part of the heavens.

DECEMBER 21, 1824.

"This winter certainly afforded but few brilliant displays of the Aurora. The following notice includes all that appear to me to require a separate description.

Late on the night of the 21st of December, the phenomenon appeared partially, and with a variable light, in different parts of the southern sky for several hours.

At seven on the following morning, it became more brilliant and stationary, describing a well-defined arch, extending from the *E. S. E.* horizon to that at *W. N. W.*, and passing through the zenith. A very faint arch was also visible on each side of this, appearing to diverge from the same points in the horizon,<sup>1</sup> and separating to twenty degrees' distance in the zenith.

It remained thus for twenty minutes, when the coruscations from each arch met, and, after a short but brilliant display of light, gradually died away."—*Ibid.*, p. 60.

N. B.—1. This winter afforded very few brilliant displays.

2. This night appeared partially in different parts of the *southern* sky.

3. At 7 next a. m., arch from *E. S. E.* to *W. N. W.* passing through the zenith.

4. A very faint arch visible on each side of this.

5. After a short but brilliant display, died away.

#### JANUARY 15, 1825.

"Early on the morning of the 15th of January the *Aurora* broke out to the southward, and continued variable for three hours between a *N. W.* and *S. E.* bearing.

From three to four o'clock, the whole horizon from south to west was brilliantly illuminated, the light being continuous almost throughout the whole extent, and reaching several degrees in height. Very bright vertical rays were constantly shooting upwards from the general mass.

At half-past five, it again became so brilliant as to attract particular notice, describing two arches passing in an east and west direction very near the zenith, with bright coruscations issuing from it; but the whole gradually disappeared with the returning dawn.

At dusk the same evening, the *Aurora* again appeared in the southern quarter, and continued visible nearly the whole night, but without any remarkable feature."—*Ibid.*, p. 61.

N. B.—1. Early a. m., *Aurora* broke out to the southward.

2. From 8h. to 4h. a. m., whole horizon from *S.* to *W.* brilliantly illuminated.

3. Very bright vertical rays shooting upward.

4. At 5h. 30m., again became very brilliant.

5. Describing two arches passing in an *E.* and *W.* direction very near the zenith.

#### JANUARY 27, 1825.

"About midnight on the 27th of January, this phenomenon broke out in a single compact mass of brilliant yellow light, situated about a *S. E.* bearing, and appearing only a short distance above the land. This mass of light, notwithstanding its general continuity, sometimes appeared to be evidently composed of numerous pencils of rays, compressed, as it were laterally, into one, its limits both to the right and left being well defined and nearly vertical. The light, though very bright at all times, varied almost constantly in intensity, and this had the appearance (not an uncommon one in the *Aurora*) of being produced by one volume of light overlaying another, just as we see the darkness and density of smoke increased by cloud rolling over cloud.

While Lieutenants Sherer and Ross and myself were admiring the extreme beauty of this phenomenon from the observatory, we all simultaneously uttered an exclamation of surprise at seeing a bright ray of the *Aurora* shoot suddenly downward from the general mass of light, and between us and the land, which was there distant only three thousand yards.

Had I witnessed this phenomenon by myself, I should have been disposed to receive with caution the evidence even of my own senses as to this last fact; but the appearance conveying precisely the same idea to three individuals at once, all intently engaged in looking towards the spot, I have no doubt that the ray of light actually passed within that distance of us."—*Ibid.*, pp. 61, 62.

N. B.—1. About midnight, broke out in a single mass of brilliant yellow light, *S. E.*

2. Only a short distance from the land.

3. Bright ray of the *Aurora* shot down from general mass of light between us and the land.

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<sup>1</sup> I am aware that this appearance is usually referred to the effect of viewing the phenomena in perspective; but I here describe appearance only.

FEBRUARY 23, 1825.

"About one o'clock on the morning of the 23d of February, the Aurora again appeared over the hills in a south direction, presenting a brilliant mass of light very similar to that just described (27th January).

The rolling motion of the light laterally was here also very striking, as well as the increase of its intensity thus occasioned. The light occupied horizontally about a point of the compass, and extended in height scarcely a degree above the land, which seemed, however, to conceal from us a part of the phenomenon.

It was always evident enough that the most attenuated light of the Aurora *sensibly dimmed the stars*, like a thin veil drawn over them.

We frequently listened for any sound proceeding from this phenomenon, but *never heard any*."—*Ibid.*, p. 62.

N. B.—1. Appeared in a south direction; brilliant.

2. Most attenuated light of the Aurora always *sensibly dimmed the stars*.

3. Frequently listened for sound, but *never heard any*.

Port Bowen.—Lat.  $73^{\circ} 18' 39''$  N. Long.  $88^{\circ} 54' 58''$  W. Winter of 1824–25. PARRY.

"On several occasions which seemed the most favorable for the purpose, the electrometer, with gold leaf, was applied to the chain, *but without the slightest perceptible effect*.

The chain was attached to the skysail masthead by glass rods, precisely in the manner described on our last voyage, the pointed end of the upper link being considerably above the masthead, and one hundred and fifteen feet from the level of the sea.

That the *atmosphere* during the winter months was *favorable to the excitement of electricity*, appeared from the facility with which a small electrical machine, constructed by Mr. Rowland, was found to act. The sparks given out by this machine, of which the cylinder was only six inches long and five in diameter, Dr. Neill considered as large as are usually elicited from apparatus of much larger dimensions in England.

Our *variation-needles*, which were *extremely light*, suspended in the most delicate manner, and, from the weak directive energy, susceptible of being acted upon by a very slight disturbing force, *were never in a single instance sensibly affected by the Aurora*, which could scarcely fail to have been observed at some time or other, had any such disturbance taken place, *the needles being visited every hour for several months*, and oftener when anything occurred to make it desirable."

—3 Parry, p. 63.

N. B.—1. Not the slightest perceptible effect produced on the electrometer.

2. Variation-needles suspended in the most delicate manner.

3. Were never in a single instance sensibly affected by the Aurora,

4. Though the needles were visited every hour for several months.

"There was no want of well-defined clouds this winter; these were almost entirely of the kind called cirro-stratus, or approaching to that modification. Cumuli and cirro-cumuli occurred only with the advance of spring.

The sky in this respect differed from that of our winter at Melville Island, and also from those at Winter Island and Igloodik, clouds occurring much more frequently than at the former, and more rarely than at the two latter stations.

This difference seems to have coincided nearly with the state of the sea in the offing at each wintering-place, clouds occurring with more frequency in proportion to the extent of open water in our neighborhood.

At Port Bowen, we had occasionally lanes of clear water in the offing as late as the 22d of January, and the ice could be heard in motion till the 11th of February; but the water was of small extent after the first month subsequent to our arrival in winter quarters.

The occasional occurrence of fog, and the appearance of a dark water-sky to the northward, frequently observed from the hills during the winter, render it extremely probable that Barrow's

## RECORD OF AURORAL PHENOMENA.

Strait was never entirely closed; a probability confirmed by the appearance of it at all times of the year in which it is accessible by ships."—*Ibid.*, p. 76.

N. B.—1. No want of well-defined clouds this winter.

2. They were almost entirely cirro-stratus.

3. Cumuli and cirro-cumuli occurred only with the approach of spring.

4. Fogs and dark water-sky.

"Lieutenant Ross tried the thickness of the salt-water ice during different periods of the winter, by digging holes in that formed upon the canal by which the ships had entered, and found it to have increased in the following ratio:—

| DATE.                   | Whole thickness<br>in inches. | Thickness above<br>the sea in<br>inches. | Proportion of that<br>above to that below;<br>the latter being = 100. |
|-------------------------|-------------------------------|--|---|
| November 20, 1824 . . . | 80.5                          | 3.8                                      | 14.23   |
| December 18, " . . .    | 88.5                          | 4.4                                      | 12.90   |
| January 1, 1825 . . .   | 45.3                          | 5.2                                      | 12.97   |
| February 2, " . . .     | 55.9                          | 6.0                                      | 12.02   |
| March 2, " . . .        | 78.0                          | 7.1                                      | 10.77   |
| April 2, " . . .        | 82.5                          | 7.8                                      | 10.44   |
| May 4, " . . .          | 86.5                          | 8.0                                      | 10.19"  |

*Ibid.*, p. 77.

N. B.—Thickness of the salt-water ice during different periods of the winter.

**Batty Bay.**—Lat.  $78^{\circ} 17' N$ . Long.  $91^{\circ} W$ . October 29, 1851. KENNEDY.

"The weather has been very boisterous for some time past, with heavy showers of snow falling every day. The sun was for a very short time visible to-day.

The Aurora Borealis bright in the southwest about 9 p. m."—Kennedy, p. 86.

**Batty Bay.**—Lat.  $78^{\circ} 17' N$ . Long.  $91^{\circ} W$ . December 28, 1851. BELLOT.

"The sky has been generally clear these last days, and this evening we have, the first time, a complete *Aurora Borealis*, or *Northern Lights*, as our Shetlanders call them (they also call them *Dancing Lights*).

Great luminous rays like the milky way, but with a slight yellowish tint, divide the vault of the sky, issuing from the zenith, from which they spread like the leaves of a palm, widening at the base.

I do not know that mention has anywhere been made of this singular phenomenon."—2 Bellot, 73.

**Lancaster Sound.**—[Near Lat.  $78^{\circ} 40' 40'' N$ . Long.  $75^{\circ} 03' 24'' W$ .] Jan. 15, 1851. KANE.

"3 a. m., a faint Aurora to the southward."—1 Kane, p. 524.

**Lancaster Sound.**—[Near Lat.  $74^{\circ} N$ . Long.  $80^{\circ} W$ .] January, 1851. KANE.

"1st. A faint Aurora visible to the southward, 11 p. m.

2d. An Aurora passing near the zenith in an E. and W. direction, 1 a. m. Two Auroras visible (7 a. m.), one passing through the zenith in an E. and W. direction, the other in faint beams radiating from the southward.

3d. An Aurora to the southward, 4 a. m.

4th. 5 a. m., an Aurora visible to the southward and westward."—1 Kane, p. 524.

**Captain Austin's Winter Quarters.**—Lat.  $74^{\circ} 10' N.$  Long.  $94^{\circ} 16' W.$

**DECEMBER, 1850.**

"The Aurora Borealis, which has hitherto afforded other voyagers so much interest, and which some writers allege to be almost constant in these regions, has not yet presented itself with any striking effect to our notice, except on the night of the 1st of December. A very complete arch in a N. N. W. and S. S. E. (true) direction, passing through the zenith, divided the celestial concave into two equal parts. It measured about  $5^{\circ}$  in width; it lasted about half an hour, and was of a whitish color. Towards the north, it became tinged with red before it disappeared. The stars were seen through it with great brilliancy; they assumed for the time the same color as the Aurora.

Some bright coruscations were seen on the morning of the 5th, shooting from the S. E. towards the zenith."—*Arctic Miscellanies*, pp. 118-14.

**JANUARY, 1851.**

"The Aurora Borealis has been observed eleven times during the month, but generally of a faint tinge. It has appeared in the form of an arch, touching the N. W. and S. E. quarters of the horizon; also in an arc between the S. W. and E. S. E. points, the altitude of the centre being  $25^{\circ}$ . Coruscations have been seen to cross the sky from various points of the horizon, and diverge in a variety of directions. During its presence, the heavenly bodies were always very bright. Many theories are advanced concerning these phenomena, one of which being that they move in columns parallel with the magnetic meridian, which is at variance with its movement in this locality."—*Ibid.*, pp. 197-98.

**FEBRUARY, 1851.**

"The Aurora Borealis has been seen more frequently, though never with that brilliancy by which it is often characterized in these regions. The number of observations in the month, of any importance, amounts to twelve. The coruscations, when detached, sifted from various points of the horizon, in light fleecy clouds, towards the zenith, sometimes of a straw color. When it has appeared in an arch, its direction has been nearly north and south, passing across the zenith. On the evening of the 20th, luminous beams of the Aurora were frequent from the southwest to the northwest points, and continued for several hours. On the following day we had fresh winds from the southwest. It has been observed that when this phenomenon appears unusually intense in any particular quarter, that a strong breeze has succeeded it from that particular direction of the compass."—*Ibid.*, pp. 250-51.

**MARCH, 1851.**

"The Aurora has appeared bright on four occasions; generally in the form of an arch, from the southeast quarter towards the north. On the night of the 25th, it was more brilliant than on any other occasion this season, making an arch from the southeast to the north, with coruscations shooting off laterally from it toward the zenith."—*Ibid.*, p. 291.

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**Lancaster Sound.**—Near Lat.  $74^{\circ} 18' 08'' N.$  Long.  $82^{\circ} 10' 18'' W.$  Dec., 1850. KANE.

"26th. Faint Aurora at noon, to the southward. An Aurora in form of a bow, passing through the zenith in a N. W. and S. E. direction.

27th. An Aurora visible at 5 a. m.; at 6 a. m., another one. In the afternoon, an Aurora passing through the zenith in a north and south direction, 10 p. m.

28th. Auroras visible; one passing  $30^{\circ}$  from the zenith, in form of an arch, to the westward, 1 a. m. and 8 a. m.

29th. An Aurora passing near the zenith in an east and west direction, 4 a. m.

31st. Auroras visible; one appeared in the form of an arch, extending to the horizon, in N. N. E. and S. W. direction, passing  $15^{\circ}$  from the zenith, 10 p. m."—1 KANE, 523.

**Lancaster Sound.**—[Lat.  $74^{\circ} 30'$  N. Long.  $90^{\circ}$  W.] December 1, 1850. KANE.

"We had an Aurora about 7h. p. m. The thermometer at  $-33^{\circ}$ , and falling. Wind steady, W. N. W. The meteor resembled an illuminated cloud; illuminated, because seen against the deep blue night sky; otherwise it resembled the mackerel fleeces and mares' tails of our summer skies at home.

It began toward the northwestern horizon as an irregular flaring cloud, sometimes sweeping out into wreaths of stratus; sometimes a condensed opaline nebulosity, rising in a zone of clearly-defined whiteness, from  $3^{\circ}$  to  $5^{\circ}$  in breadth up to the zenith, and then arching to the opposite horizon. This zone resembled more a long line of white cirro-stratus than the Auroral light of the systematic descriptions. There was no approach to coruscations, or even rectangular deviations from the axis of the zone. When it varied from a right line, its curvatures were waving and irregular, such as might be produced by the wind, but having no relation to the observed air-currents at the earth's surface. It passed from the due northwest, between the Pleiades and the Corona Borealis; the star of greatest magnitude in the latter of these constellations remaining in the centre, although its waving curves sometimes reached the Pleiades. At the zenith, its mean distance from the polar star was  $7^{\circ}$  south, and it passed down, increasing in intensity near Vega, in Lyra, to the southeast.

There was throughout the arc no marked seat of greatest intensity. Around the corona of the north, its light was more diffused. The zone appeared narrowed at the zenith, and bright and clear, without marked intermission, to the southeast. The frost-smoke was in smoky banks to the northwest; but the Aurora did not seem to be affected by it, and the compass remained constant."—1 Kane, p. 245-46.

**Griffith Island.**—Lat.  $74^{\circ} 30'$  N. Long.  $95^{\circ} 20'$  W. Winter of 1850-51. OSBORNE.

"With one portion of the phenomena of the North Sea we were particularly disappointed—and this was the Aurora.

The colors, in all cases, were vastly inferior to those seen by us in far southern latitudes; a pale-golden or straw color being the prevailing hue. The most striking part of it was its apparent proximity to the earth.

Once or twice the Auroral coruscations accompanied a moon in its last quarter, and generally previous to bad weather.

On one occasion, in Christmas week, the light played about the edge of a low vapor which hung at a very small altitude over us; it never, on this occasion, lit up the whole under surface of the said clouds, but formed a series of concentric semicircles of light, with dark spaces between, which waved, glistened, and vanished, like moonlight upon a heaving but unbroken sea.

At other times, a stream of the same colored vapor would span the heavens through the zenith, and from it would shoot sprays of pale-orange color for many hours; and then the mysterious light would again as suddenly vanish."—Osborne, pp. 164-65.

**Griffith Island.**—Lat.  $74^{\circ} 30'$  N. Long.  $95^{\circ} 20'$  W. December, 1850. MARKHAM.

"The Aurora Borealis began also to dart its ever-changing rays across the heavens. On the 1st of December [1850], a very complete arch, passing through the zenith, divided the celestial concave into two equal parts, of a whitish color tinged with red. The stars were seen through it with great brilliancy, assuming, for the time, the same color as the Aurora.

On the 5th, also, some very bright coruscations were seen to dart their rays towards the zenith.

Whenever this phenomenon appeared unusually intense in any particular quarter, a strong breeze generally succeeded from the same direction."—Markham, p. 70.

**At Sea.**—Lat.  $74^{\circ} 31'$  N. Long.  $111^{\circ} 38'$  W. September 20, 1819. PARRY.

"The wind blew hard from the northward during the night, with a good deal of snow; and the thermometer was at  $10\frac{1}{2}^{\circ}$  at midnight.

The Aurora Borealis was seen faintly in the S. S. W. quarter of the heavens."—1 Parry, 93.



**Barrow Strait and Lancaster Sound.**—Between Lat.  $74^{\circ} 36' 53''$  N., Long.  $91^{\circ} 45' 45''$  W., and Lat.  $74^{\circ} 20' 06''$  N., Long.  $86^{\circ} 26' 16''$  W. December, 1850. KANE.

"3d. Faint Aurora visible for a short time.

5th. A transit Aurora, ending with luminous bands to the S. E.

6th. Faint Aurora, 4 a. m., to the west (true).

8th. Faint Aurora, 8 a. m., to the southward and eastward (true); another, 10 a. m., to the N. W. (true).

11th. An Aurora to the southward, 4 a. m."—1 Kane, p. 522.

**Off Beechy Island.**—[Lat.  $74^{\circ} 40'$  N. Long.  $92^{\circ}$  W.] November 8, 1850. KANE.

"Aurora to the southward and westward, 5h. a. m. (true).

Ten Auroras observed during the month."—1 Kane, p. 520.

**Assistance Harbor (Cornwallis Land).**—Lat.  $74^{\circ} 40'$  N. Long.  $94^{\circ} 16'$  W. SUTHERLAND.

DECEMBER, 1850.

"The Aurora Borealis was frequently observed, but the extent and brilliancy of this beautiful meteoric phenomenon never equalled what had been seen in September and October, while crossing the Atlantic, in the latitude of Cape Farewell."—Sutherland, 1, p. 442.

JANUARY, 1851.

"The sky, during the hours of daylight—which, by this time, were lengthening out very plainly—was frequently spread over with fleecy clouds; and at night the Aurora, of a beautiful golden color, danced from east to west in vivid coruscations, and enlivened our midnight scenes, although, as has been remarked already, they were much less vivid than in more southern latitudes."—Ibid., pp. 457–58.

**Barrow Strait (off Griffith Island).**—[Lat.  $74^{\circ} 45'$  N. Long.  $94^{\circ}$  W.] September, 1850. KANE.

"12th. A feeble Aurora at midnight.

15th. A feeble Aurora."—1 Kane, p. 516.

**Winter Harbor.**—Lat.  $74^{\circ} 47' 18''$  N. Long.  $110^{\circ} 49'$  W. 1819–20. PARRY.

OCTOBER 18, 1819.

"On the evening of the 18th, the Aurora Borealis was seen very faintly, consisting of a stationary white light in the southwest quarter, and near the horizon."—1 Parry, 109.

OCTOBER 20, 1819.

"Between six and eight p. m., we observed the Aurora Borealis, forming a broad arch of irregular white light, extending from *N. N. W.* to *S. S. E.*, the centre of the arch being  $10^{\circ}$  to the eastward of the zenith. It was most bright near the southern horizon; and frequent, but not vivid, coruscations were seen shooting from its upper side towards the zenith.

The magnetic needle was not sensibly affected by this phenomenon."—Ibid., p. 111.

N. B.—1. Light most bright near southern horizon.

2. Magnetic needle not sensibly affected.

NOVEMBER 9, 1819.

"On the same evening, the weather being fine and clear, the Aurora Borealis was seen for nearly two hours, forming a long, low, irregular arch of light, extending from north to south in the western quarter of the heavens, its altitude in the centre being  $3^{\circ}$  or  $4^{\circ}$ . The electrometer-chain was hoisted up to the masthead, and its lower end brought down to the ice, so as to keep it perfectly clear of all the masts and rigging, which method was used throughout the winter; but no sensible effect was produced on the gold leaf. It was tried a second time, after the sky became full of white fleecy clouds, but with as little success."—*Ibid.*, p. 115.

NOVEMBER 12, 1819.

"The thermometer having fallen to  $-81^{\circ}$ , we expected to have seen the sun again, and looked out from the masthead for that purpose, but it did not reappear.

At six p. m., the Aurora Borealis was seen in a broken irregular arch, about  $6^{\circ}$  high in the centre, extending from N. W. by N. to S. by W., from whence a few coruscations were now and then faintly emitted towards the zenith."—*Ibid.*, 115.

NOVEMBER 13, 1819.

"From eight p. m. till midnight, on the 13th, it was again seen in a similar manner from S. W. to S. E., the brightest part being in the centre, due south."—*Ibid.*, p. 115.

NOVEMBER 15, 1819.

"On the 15th, Lieutenant Beechey informed me that he had seen, in the N. N. W. and S. E. quarters, some *light transparent clouds*, from which *columns of light* were thrown upwards, resembling the Aurora Borealis; those to the S. E., being opposed to a very light sky, had a light-brown appearance."—*Ibid.*, p. 115.

- N. B.—1. Light transparent clouds N. N. W. and S. E.  
 2. From which columns of light were thrown upwards,  
 3. Resembling the Aurora Borealis.

NOVEMBER 16, 1819.

"This phenomenon was again observed on the 16th, consisting of a bright stationary light from S. S. W. to S. by E., and reaching from the horizon to the height of about  $6^{\circ}$  above it."—*Ibid.*, p. 116.

NOVEMBER 17, 1819.

"At three p. m. a remarkable variety of the Aurora Borealis was seen by several of the officers. Having about this time been confined for a few days to my cabin by indisposition, I am indebted to Lieutenant Beechey for the following description of it:—

*Clouds*, of a light-brown color, were seen diverging from a point near the horizon, bearing S. W. by S., and shooting pencils of rays upwards at an angle of about  $45^{\circ}$  with the horizon. These rays, however, were not stationary as to their position, but were occasionally extended and contracted. From behind these, as it appeared to us, flashes of white light were repeatedly seen, which sometimes streamed across to the opposite horizon; some passing through the zenith, others at a considerable distance on each side of it.

This phenomenon continued to display itself brilliantly for half an hour, and then became gradually fainter till it disappeared about four o'clock. The sun, at the time of the first appearance of this meteor, was on nearly the same bearing, and about  $5^{\circ}$  below the horizon."—*Ibid.*, pp. 116-17.

- N. B.—1. Remarkable variety of Aurora Borealis.  
 2. Clouds of a light-brown color.

NOVEMBER 18, 1819.

"The stars of the second magnitude in Ursa Major were just perceptible to the naked eye a little after noon this day, and the Aurora Borealis appeared faintly in the southwest at night."—*Ibid.*, p. 117.

NOVEMBER 26, 1819.

"On the 26th, in the morning, some vivid coruscations of the Aurora Borealis were observed from S. to N. W., commencing at 4° or 5° of altitude, and streaming toward the zenith."—*Ibid.*, p. 118.

DECEMBER 14, 17, 1819.

"On the 14th of December, the day was beautifully serene and clear, and there was more redness in the southern sky about noon than there had been for many days before; the tints, indeed, might almost be called prismatic.

At 6 p. m., the Aurora Borealis was seen forming two concentric arches, passing from the western horizon on each side of the zenith to within 20° of the opposite horizon, resting on a dark cloud about seven degrees high, from behind which the light appeared to issue, and partially streaming from the cloud to the zenith. No effect was produced by it on the electrometer or the magnetic needle.

The appearance I have just described of the light seeming to issue from behind an obscure cloud, is a very common one; it is not always, however, easy to tell whether any cloud really exists, or whether the appearance is a deception arising from the vivid light of the Aurora being contrasted with the darker color of the sky near it.

On the 17th, in the morning, this phenomenon was again observed, being a stationary faint light from S. W. to W. S. W."—*Ibid.*, p. 121.

N. B.—1. At 6 p. m. Aurora formed two arches.

2. Passing from western horizon on each side of zenith.

3. Resting on a dark cloud,

4. From behind which light seemed to issue.

5. No effect produced on electrometer or needle.

6. The appearance of light seeming to issue from behind a cloud is a very common one.

DECEMBER 19, 1819.

"On the 19th, the weather being fine and clear, the Aurora borealis appeared frequently at different times of the day, generally from the south to the W. N. W. quarters, and not very vivid. From eight p. m. till midnight, however, it became more brilliant, and broke out in every part of the heavens, being generally most bright from S. S. W. to S. W., where it had the appearance of emerging from behind a dark cloud about five degrees above the horizon.

We could not, however, help feeling some disappointment in not having yet witnessed this beautiful phenomenon in any degree of perfection which could be compared to that which occurs at Shetland, or in the Atlantic, about the same latitude as these Islands."—*Ibid.*, p. 122.

N. B.—1. Aurora appeared frequently at different times of the day.

2. Generally from S. to the W. N. W. quarters; not very vivid.

3. From 8 p. m. to 12, more brilliant.

4. Most bright from S. S. W. to S. W.,

5. Where it appeared to emerge from behind a dark cloud.

6. We had not yet witnessed this beautiful phenomenon in any degree of perfection.

DECEMBER 20, 1819.

"On the morning of the 20th, the Aurora Borealis again made its appearance in the N. W., which was more to the northward than usual. It here resembled two small bright clouds, the one nearly touching the other, and being about seven degrees above the horizon. These remained quite stationary for half an hour, and then broke up into streamers shooting rapidly towards the zenith."—*Ibid.*, p. 122.

JANUARY 8, 1820.

"At half-past five p. m. on the 8th, the Aurora Borealis was seen forming a broken and irregular arch of white light, 10° or 12° high in the centre, extending from N. by W., round by W., to S. S. E., with occasional coruscations proceeding from it towards the zenith. It continued thus for an hour, and reappeared from eight o'clock till midnight in a similar manner, making; how-

ever, but a poor display of this beautiful phenomenon. Neither the magnetic needle nor the gold leaf of the electrometer were, in either instance, in the slightest degree affected by it."—*Ibid.*, p. 183.

#### JANUARY 11, 1890.

"At eight a. m. on the 11th, faint coruscations of the Aurora Borealis were observed to dart with inconceivable rapidity across the heavens from *W. N. W. to E. S. E.*, from horizon to horizon, and passing about  $25^{\circ}$  to the south of the zenith.

At noon to-day, the temperature of the atmosphere had got down to  $49^{\circ}$  below zero, being the greatest degree of cold which we had yet experienced."—*Ibid.*, p. 183.

N. B.—1. At 8h. a. m., faint coruscations,

2. Across the heavens from *W. N. W. to E. S. E.*, from horizon to horizon,

3. Passing  $25^{\circ}$  to the south of the zenith.

4. At noon to-day, temperature  $-49^{\circ}$ .

#### JANUARY 15, 1890.

"On the evening of the 15th, the atmosphere being clear and serene, we were gratified by a sight of the *ONLY very brilliant* and diversified display of Aurora Borealis which occurred during the whole winter. I believe it to be almost impossible for words to give an idea of the beauty and variety which this magnificent phenomenon displayed; I am at least certain that no description of mine can convey an adequate description of it, and I therefore gladly avail myself of the following account, by Captain Sabine, which was furnished by my request, at the time, for insertion in my Journal.

'Mr. Edwards, from whom we first heard that the Aurora was visible, described it as forming a complete arch, having its legs nearly north and south of each other, and passing a little to the eastward of the zenith.

'When I went upon the ice, the arch had broken up. Towards the southern horizon was the ordinary Aurora, such as we had lately seen on clear nights, being a pale light, apparently issuing from behind an *obscure cloud*, at from six to twelve degrees of altitude, extending more or less towards the east or west on different nights, and at different times of the same night, having no determined centre or point of bisection, the greater part, and even at times *the whole of the luminous appearance being sometimes to the east, and sometimes to the west of south, but rarely seen in the northern horizon*, or beyond the east and west points of the heavens. This corresponds with the Aurora most commonly noticed in Britain, except that it is there as peculiar to the northern as *here to the southern horizon*, occasionally shooting upwards in rays and gleams of light. It was not distinguished by any unusual brilliancy or extent on this occasion; the splendid part of the phenomenon being detached, and apparently quite distinct.

'The luminous arch had broken into irregular masses, streaming with such rapidity in different directions, varying continually in shape and intensity, and extending themselves from north, by the east, to south. If the surface of the heavens be supposed to be divided by a plane running through the meridian, the Aurora was confined, during the time I saw it, to the eastern side of the plane, and was usually most vivid and in longer masses in the *E. S. E.* than elsewhere. Mr. Parry and I noticed to each other that, where the Aurora was very brilliant, the stars seen through it were somewhat dimmed; though this remark is contrary to former experience.

'The distribution of light has been described as irregular and in constant change; the various masses, however, seemed to have a tendency to arrange themselves into two arches; one passing near the zenith, and a second about midway between the zenith and horizon, both having generally a north and south direction, but curving towards each other, so that their legs produced a complete ellipse; these arches were as quickly dispersed as formed. At one time, a part of the arch near the zenith was bent into convolutions, resembling those of a snake in motion, and undulating rapidly; an appearance we had not before observed. The end towards the north was also bent like a shepherd's crook, which is not uncommon. It is difficult to compare the light produced by the Aurora with that of the moon, because the shadows are rendered faint and indistinct by reason of the general diffusion of the Aurora; but I should think the effect of

the one now described scarcely equal to that of the moon when a week old. The usual pale light of the Aurora strongly resembles that produced by the combustion of phosphorus. A very slight tinge of red was noticed on this occasion, when the Aurora was most vivid, but no other colors were visible. Soon after we returned on board, the splendid part wholly disappeared, leaving only the ordinary light near the horizon; in other respects the night remained unchanged, but on the following day it blew a fresh gale from the north and N. N. W.

'This Aurora had the appearance of being very near us, and we listened attentively for the sound which is said sometimes to accompany brilliant displays of this phenomenon, but neither on this nor on any other occasion could any be distinguished.'

On the following day, the Aurora was repeatedly seen for an hour or two together, assuming the shape of a long low arch, from  $8^{\circ}$  to  $12^{\circ}$  high in the centre, extending from south to N. W.—*Ibid.*, pp. 134–35–36.

- N. B.—1. The only brilliant display of Aurora seen during the whole winter.  
 2. Towards southern horizon, the ordinary Aurora.  
 3. Apparently issuing from behind a cloud.  
 4. Aurora seen sometimes east, and sometimes west of south, but rarely seen in the northern horizon.  
 5. Aurora in Britain as peculiar to the northern horizon as here to the southern.  
 6. This Aurora appeared to be very near us.  
 7. Heard no sound, which is said sometimes to accompany brilliant Aurora.

FEBRUARY 8, 1820.

"At six p. m., the Aurora Borealis appeared very faintly in a horizontal line of white light, extending from S. to S. S. W. and about  $5^{\circ}$  above the horizon. From nine till eleven, it was again seen quite stationary and very faint, from S. S. W. to W. N. W., at three or four degrees of altitude.

Captain Sabine had, for some time past, kept one of the needles used for determining the intensity of the magnetic force, suspended by a silk thread, in the Observatory, for the purpose of remarking more satisfactorily than it could be done on board the ships, whether any effect was produced upon it by the Aurora Borealis.

It might be supposed that in these regions, where the directive power of the needle had almost entirely ceased, it would be more easily disturbed by any adventitious cause than in those parts of the globe where the directive energy was greater; but we never could perceive the slightest derangement to be produced in it by the Aurora."—*Ibid.*, p. 139–40.

- N. B.—1. At 6 p. m., appeared very faintly.  
 2. From 9 till 11, again seen very faint.  
 3. Could never perceive the slightest derangement of the needle produced by the Aurora.

FEBRUARY 8, 1820.

"On the 8th, at noon and for half an hour after, an appearance presented itself in the heavens which we had not before observed. A thin fleecy cloud, of a pale-red color, and shaped like part of an arch, commenced pretty strongly from the top of the land in the N. W., and ran more and more faintly to N. by W., beyond which it could no longer be traced; it was here fifteen degrees above the northern horizon. On looking for a continuation of it in the opposite quarter of the heavens, we perceived a larger portion of another and fainter arch of pale-red or orange, commencing at the horizon in the E. by N., and extending to  $60^{\circ}$  of altitude in the N. N. E., so as evidently not to form a part of the western arch. Captain Sabine afterwards observed the whole phenomenon to alter its position; the leg of the eastern arch shifting considerably more to the southward. In the evening, the Aurora Borealis was seen forming a confused and irregular arch of white light, continually varying in brightness, about  $8^{\circ}$  high in the centre, and extending from S. by E., round by the W., to N. N. W. From the upper part of this arch, coruscations occasionally shot upwards, and a few streamers now and then burst forth also from the horizon in the S. S. E.; these latter went nearly up to the zenith, while the rest were more faint, and did not reach so high. I am confident that Aldebaran and the Pleiades were very

sensibly dimmed by the most vivid of the coruscations, which appeared, in this respect, not to differ from any thin vapor or cloud floating in the atmosphere. The gold leaf of the electrometer, as well as the magnetic needle suspended in the Observatory, was carefully attended to, but neither of them suffered any sensible disturbance."—*Ibid.*, pp. 141-42.

N. B.—1. At noon, a thin fleecy cloud.

2. Commenced in N. W., and ran more faintly to N. by W.

FEBRUARY 10, 1820.

"At a quarter past six p. m. on that day, the Aurora began to appear in *the south and S. W.*, in detached and not very brilliant pencils of rays darting upwards from near the horizon.

Soon after, an arch of the usual broken and irregular kind appeared in the western quarter of the heavens, extending from *N. W. to south*, and being from  $5^{\circ}$  to  $8^{\circ}$  high in the centre. From the upper part of the arch proceeded a few faint coruscations reaching to no great height.

At a quarter before seven, a second and better-defined arch crossed over *from S. E. to N. W. by N.*, passing on the northern side of the zenith, from which it was distant from  $10^{\circ}$  to  $15^{\circ}$  in the centre.

This arch was very narrow, and seemed to be formed of two parts, each shooting with great rapidity from those parts where the legs stood, and joining in the centre. In a short time, this second arch entirely disappeared, and the first became less brilliant.

The phenomenon was then for some minutes confined to some bright pencils of rays *in the south and S. S. E.*, which were generally parallel to each other, but sometimes also diverged at an angle of about  $15^{\circ}$ .

At a quarter past seven, two long and narrow streams of light crossed over, at  $35^{\circ}$  to  $40^{\circ}$  of altitude, on the western side of the zenith, *from the N. W. by N. and south points* of the horizon. Their upper ends did not quite meet in the centre so as to complete an arch, but inclined to the shape of shepherds' crooks, as described on the 15th of January, and often remarked by former observers; but they were neither so brilliant nor so well defined as when we saw them before.

About a quarter before eight, as we were returning on board from the Observatory, the low arch to the westward first described, and which had never altogether disappeared, increased considerably in brilliancy. It was still, however, so irregular as to appear in detached roundish clouds or blotches, from which the pencils, which shot upwards, appeared immediately to proceed. These pencils, which were infinitely varied both in length and breadth, were observed to have also a slow, though very sensible, *lateral motion from north to south and vice versa*; and we remarked on one occasion that, when two of them met and had the appearance of overlapping, they produced, for about fifteen seconds, the most intense degree of light we had yet seen from the Aurora. *The pencils appeared generally to travel bodily in one direction*, but sometimes to widen out in both at the same time.

We were all decidedly of opinion that the fixed stars were very perceptibly dimmed by this phenomenon, which gradually disappeared by nine o'clock."—*Ibid.*, p. 142.

N. B.—1. At 6 p. m., a very brilliant display S. and S. W.

2. Soon after, an arch from N. W. to S.

3. At a quarter before seven, a second arch, better defined, from S. E. to N. W. by N.

4. Then for some minutes confined to some pencils of rays in S. and S. E.

5. At 7h. 15m., two long streams of light, west side of zenith, from N. W. by N. and S. points of the horizon.

6. Lateral motion from north to south.

7. The pencils appeared to travel bodily in one direction.

8. Disappeared at 9h. p. m.

9. Fixed stars perceptibly dimmed.

FEBRUARY 11, 1820.

"At half-past eight p. m., the Aurora Borealis made its appearance for a short time in an arch, very irregular but at times very bright, *from S. W. to S. S. E.*, at  $4^{\circ}$  or  $5^{\circ}$  above the horizon in the centre."—*Ibid.*, p. 144.

## FEBRUARY 19, 1820.

"At half-past ten p. m. on the 19th, the Aurora Borealis was seen, as described by Lieut. Beechey, in bright coruscations, shooting principally from the *S. by W. quarter*, across the zenith, to *N. N. E.*, and partially in every part of the heavens.

The light, when most vivid, was of a pale-yellow, at other times white, excepting to the southward, in which direction a dull red tinge was now and then perceptible. The coruscations had a tremulous waving motion, and most of them were crooked towards the *E. N. E.*

The fresh gale which blew at the time from the *N. N. E.* appeared to have no effect on the Aurora, which, as before observed, streamed directly to windward, and this with great velocity.

The brighter part of this meteor *dimmed whatever stars it passed over, even those of the first magnitude*; and those of the second and third magnitude so much as to render them scarcely visible.

The wind blew too strong for the electrometer to be used, but Kater's compass was not in the slightest degree affected.

The whole of the phenomenon disappeared in about three-quarters of an hour."—*Ibid.*, p. 147.

N. B.—Dimmed whatever stars it passed over, even those of the first magnitude.

## MARCH 4, 1820.

"The Aurora Borealis was seen faintly near the *S. S. W.* horizon, for three or four hours before midnight."—*Ibid.*, p. 152.

## MARCH 8, 1820.

"From nine p. m. till midnight, the Aurora Borealis appeared faintly in the horizon *to the south*, occasionally streaming towards the zenith in coruscations of pale-white light."—*Ibid.*, p. 156.

## APRIL 16, 1820.

"In the afternoon of the 16th, the weather became clear and nearly calm; Mr. Hooper and myself observed a coloring in some light fleecy clouds, which formed one of the most beautiful phenomena that I had ever seen.

These clouds, which were small and white, and almost the only ones in the heavens, assumed, as they approached and passed under the sun, the most soft and exquisite tints of light lake, bluish-green, and yellow about their edges that can possibly be imagined. These tints appeared only when the clouds were within  $15^{\circ}$  or  $20^{\circ}$  of the sun, were brightest as they passed under it, which they did as close as  $2^{\circ}$ , and began to be again indistinct at  $10^{\circ}$  from it. Some of the clouds remained colored in this way for upwards of a quarter of an hour. There did not seem to be any regular arrangement of tints, as in the prismatic spectrum, but the lake was always next the sun."—*Ibid.*, p. 166.

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Winter Harbor.—Lat.  $74^{\circ} 47' 13''$  N. Long.  $110^{\circ} 49'$  W. FISHER.

## OCTOBER 27, 1819.

"The Aurora Borealis was seen *to the southward*, but it was too faint to deserve any description."—Fisher, p. 150.

## NOVEMBER 17, 1819.

"Between three and four o'clock this afternoon, a remarkable cloud was observed in the southwest; the centre of it, indeed, bore *S. W. by S.* (true). It diverged from a centre, at the horizon, in straight lines or columns, which extended to a great distance over the surface of the sky. The lower edge of it, on each side, was very straight and well defined, and formed an angle of about  $45^{\circ}$  with the horizon. Directly over its centre, instead of straight lines, it had more the appearance of an immense volume of smoke than anything else. The whole was compared by our gunner to a powder magazine in a state of explosion; which those who had an opportunity of seeing such a sight thought a *very apt* comparison, for the reflected rays of the sun, which

illuminated that part of the sky behind the cloud, gave it very much the appearance of an immense explosion.

It is probable that this remarkable cloud had some connection with the Aurora Borealis; for after it had vanished, which took place about six o'clock, that phenomenon was seen in the same part of the heavens that the cloud occupied. It made its appearance, indeed, before the cloud disappeared entirely, but not before it had lost its radiated form, and dispersed so much that nothing particular could be seen about it."—*Ibid.*, pp. 156–57.

N. B.—1. Between three and four p. m. remarkable cloud.

2. It is probable that this remarkable cloud had some connection with the Aurora Borealis.

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Wellington Channel.—[Lat.  $74^{\circ} 54'$  N. Long.  $98^{\circ}$  W.] October, 1850. KANE.

"17th. A faint Aurora to the southward (true) at one a. m.

21st. A faint Aurora  $8^{\circ}$  east of magnetic north.

23d. A faint Aurora, more bright, with segment.

26th. Very faint Aurora.

27th. Bistre-colored auroral segment,  $20^{\circ}$  east of magnetic axis.

29th. Faint nebulous Aurora.

31st. Observed a small Aurora to the northward (by compass) at one a. m."—1 Kane, p. 519.

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Baffin's Bay.—Lat.  $75^{\circ} 12'$  N. July 21, 1817. O'REILLY.

"July 21, 1817. Thermometer  $84^{\circ}$ ,  $48^{\circ}$ ,  $42^{\circ}$ . Wind, a perfect calm.

At three a. m. this morning, a most magnificent display of radiation occurred, of which a sketch has been attempted.

The cirrus radiation here remarked is always observed to issue from a body of detached clouds assuming the form of an arch. Whether this curved arrangement be actually in a portion of a circumference of a circle, or merely an optical delusion, I will not undertake to assert, but the curve invariably appeared to me arched as I have related. The basis arch of the phenomenon which occurred this morning was of amazing span, embracing several leagues of sea, the central radius passing through the horizon in *nearly E. by N. per compass*; which corresponds closely with the point of variation.

The radiation darted rapidly and irregularly towards the opposite point of the sky in pale white spires. The atmosphere in the southern region immediately became suffused with whitish-brown cirro-stratus. Soon afterwards, various beautiful changes to minute cirro-cumulus and comoid cirrus were observable.

Within the arch lay a long linear bed of cirro-stratus, almost black, which preserved a horizontal position and unaltered form during the radiation and the changes mentioned. In the space of three hours from the first appearance, the whole was dissolved and dissipated, leaving the atmosphere free of visible cloud, but not quite clear, being of a milky blue.

I should not have intruded upon the reader's notice the detail of this radiation, had I not been convinced, by repeated observations, that there exists a close, it may be said a direct, correspondence between its appearance and the variation of the needle. From what cause this singular coincidence proceeds, it will still longer, I fear, remain to be explored. The facts, however, which are herein exhibited, may be relied on for the accuracy and faithfulness of report, and may induce some enlightened and able mind to study a satisfactory illustration of the phenomenon.

It is right, also, to inform the reader that, during the formation and continuance of the radiation, no irregular motion of the compass was observable; the entire process appearing to go on at an elevation far too great to admit of any influence on the needle.

The state of the cloud, its being invariably a base of distinct cirro-stratus in a curved chain, the



radiation always issuing, as it would appear, from behind the cirro-stratus, and having a cirrous consistence, and all those appearances being usually succeeded by a wind from the opposite point, besides the correspondence with the variation, are circumstances well worthy the philosopher's attention."—O'Reilly, pp. 169-71.

**Northumberland Sound (Winter Quarters).—**Lat.  $76^{\circ} 52'$  N. Long.  $97^{\circ}$  W. December, 1852. BELCHER.

"On the evening of the 2d of December, about nine p. m., the first well-authenticated Aurora was observed. All our instruments being then available, I was anxious to ascertain its effect on them. Mr. Cheyne was directed to report on the electrometers, and I add his remarks, as I believe he was called in time to see it in part.

'**Sir:** Last night, at 9.30, I observed an Aurora, a light narrow streak, extend from the summit of the Observatory Hill, passing immediately through the zenith in a direction south by east (true), terminating in a feather about  $25^{\circ}$  north of the zenith (?). Four cumulous-shaped masses appeared as though only about a couple of hundred feet from the mastheads; these masses lasted about three minutes, and then suddenly disappeared, having apparently shifted their position about twenty feet during that time. The long streak gradually vanished in about eight minutes. The magnetometer read  $116.50^{\circ}$ , was perfectly steady; nor was the electrometer in the least affected. The sky was perfectly clear.

(Signed)

J. P. CHEYNE, Lieutenant.

December 3, 1852.'

Mr. Cheyne was not an observer; he probably took this  $116.50^{\circ}$  from the register for nine hours,<sup>1</sup> which is there so recorded, but he could not judge of the steadiness of the magnetometer: at eight it was  $117.80^{\circ}$ ; at ten,  $120.60^{\circ}$ . But it is *not clear to my mind* that it was not affected, and that the causes which produced this Aurora had not been in action the last eight hours; viz: from four p. m. until midnight, when it reached  $137.80^{\circ}$ , equal to  $27.60^{\circ}$  of deflection; a disturbance not before recorded. Even between nine and midnight, we have a deflection of  $21.80^{\circ}$ ! The barometer, during the interval between eight and midnight, suddenly changed from 29.860 to 29.650, regaining its height, and rising to 29.900 when the magnetometer, at sixteen hours, showed 107.90.

I had almost begun to conjecture that we were in too cold a medium, or that it might not extend to so high a latitude. Considering, too, that its first appearance generally occurs with the first shades of winter, I could hardly understand its prolonged absence. I had observed it to the north of Behring's Strait on the 25th August, and continuously up to the 5th October, in its greatest brilliancy; and in Wales, at Swansea, in August. But I notice that Parry, in his first voyage, and nearest to us, did not record it until the 8th of January; on his third, which follows in order of latitude, in October and November; and in his second, in October. I did not witness it myself; indeed, it was not reported. I casually heard of it next day, and issued orders 'invariably to call me.' It was only on perusing the official report called for from Lieut. Cheyne, that I was induced to search the magnetometer records for its motions.

December 5. Another Aurora, noticed this evening, presented vertical shoots or broom-like fasciæ shooting towards the zenith (from behind the hill N. N. W), in pale flame-tinted rays, to an altitude of  $20^{\circ}$ . No disturbance was recorded, but it is highly probable that the variations registered at nine and ten p. m. are attributable to this influence. It recurred about midnight, but it is not indicated by the magnetometer. At noon, it is suddenly deflected."—Belcher, 1, p. 178.

"On the 6th, 9th, and 10th of December, further exhibitions of Aurora occurred, and some slight deflections of the magnetometer were apparent, but generally preceding or following.

<sup>1</sup> All terms of time refer to astronomical periods from noon to noon.

About three a. m. on the 12th, the Aurora was reported by the officer of the watch as very brilliant. But as I was comfortably in bed, and it was beyond my examination, and would vanish before I could possibly be in a proper state to receive such a delicate visitor, I directed Messrs. May and Cheyne to pay every attention. It was Mr. May's guard at the magnetometer, and Mr. Cheyne was excused watch solely to attend to the electrometers, &c. It was asserted that the electric fluid was noticed on the wires *fairly caught*; *certainly* Mr. Cheyne found no disturbance. I am not quite sure that he had his instruments placed in connection with his wires, or that he reached in time, possibly thinking as I did. (?) Mr. May repaired to the Observatory, and, unfortunately, my later orders were not then in force, or we should have had a full history of this visitation. The magnetometer exhibited the most unmistakable signs of disturbance, moving instantaneously from  $114^{\circ}$  to  $128^{\circ}$ , and up to  $150^{\circ}$ , returning at four a. m. to  $117.90$ .

This, then, I consider as strong proof; and, taking into consideration other very decided deflections when no cause was apparent, I am induced to believe that the affection precedes or follows what may be indistinct, or not at all noticed by simple atmospheric observers, and nothing short of very close watching at the magnetometer will indicate the truth. But it must be borne in mind that this extra duty is a delicate service, and, to maintain even moderate interest, I know full well that the greatest tact is necessary to keep up the importance of the operators. No 'soft sawder' will do here; it is only by making the observer feel his importance, and in this aspect his responsibility to the civilized world, that he can be persuaded to extend his labors. Science will never be driven.

This Aurora was reported 'to have been duly captured, but broke the wires;' and as we could not find any of *her* (she has become a female) on the wires, and I could obtain no direct testimony (but the reverse) that Mr. Cheyne's electrometers were not influenced, the question remained *in dubio*."—*Ibid.*, p. 178.

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**At Sea.**—Lat.  $77^{\circ} 55'$  N. Long.  $0^{\circ} 55'$  W. May 20, 1818. Scoresby.

"The nights being light, the Aurora Borealis could not be seen; but on the evening of the 20th of May, an appearance was observed very much resembling the Aurora Borealis, yet no signs of electricity were observed in the electrometer applied to the conductor."—1 Scoresby, 383.

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**Van Rensselaer Harbor (N. E. of Smith's Sound).**—Lat.  $78^{\circ} 45'$  N. Long.  $71^{\circ}$  W. KANE.  
NOVEMBER 13, 1853.

"Three a. m. Nebulous patch to the south by east, closing in S. S. W. with slight illumination.

NOVEMBER 26, 1853.

Nine p. m. Bright belt crossing the zenith from north to south; wavy in outline, but destitute of color or scintillation.

NOVEMBER 28, 1853.

One a. m. Bright auroral light to the southward ( $S. 14^{\circ} W.$ ).

Four a. m. Same; west  $21^{\circ}$  south to south, quite fixed; a nebulous patch of illuminated sky; elevation never exceeding  $30^{\circ}$ .

NOVEMBER 30, 1853.

Five hours thirty minutes p. m. Aurora of same character but very faint, nearly due east; faded by 7 p. m.

DECEMBER 1, 1853.

Eight p. m. Two horizontal belts to S. W.

DECEMBER 4, 1853.

Two a. m. A very slight illumination noted to S. W.

DECEMBER 8, 1853.

Three a. m. Same, more defined, from N. E., at altitude of  $80^{\circ}$ , passing through the zenith and lost in diffused light.

DECEMBER 24, 1853.

Four to eight a. m. Bright 'spots' described by watch on the horizon to S. W. Perhaps auroral.

DECEMBER 29, 1853.

Twelve (noon) to four p. m. Light illumination above northern horizon.

JANUARY 27, 1854.

Five a. m. to eight a. m. Brilliant Aurora of same character as that of November 26; no colors; needle undisturbed; altitude  $70^{\circ}$ .

JANUARY 28, 1854.

Twelve (midnight). A slight auroral light, extending from S. E. to N. in a belt.

FEBRUARY 4, 1854.

Four hours thirty minutes a. m. Bright arch to W. and N. W. extending towards zenith.

FEBRUARY 5, 1854.

Seven p. m. Auroral arc; altitude of centre of segment  $35^{\circ}$ ; direction from N. to E. N. E.

NOVEMBER 18, 1854.

Four p. m. Nebulous patches S. and S. W. (Too light to observe.)

NOVEMBER 18, 1854.

Six p. m. A belt seen to S. W.

NOVEMBER 23, 1854.

Two a. m. Slight approach to arch-like arrangement.

DECEMBER 14, 1854.

Ten p. m. Tolerably defined arc passing through zenith; limbs lost about  $40^{\circ}$  above horizon; quite anomalous.

JANUARY 7, 1855.

Twelve to two a. m. Bright patch of illumination about  $15^{\circ}$  above horizon, S. by W., as seen from outside floes.

FEBRUARY 10, 1855.

Two a. m. Diffused light with slight motion, S. by W.

GENERAL REMARKS.—During second winter only were marked exhibitions noted. In but two instances—viz: January 27, 1854, and February 10, 1855—was any motion detected allied to 'merry dancers' of the south. The processes had no apparent connection with the magnetic dip, and in no case did the needle of our unifilar indicate disturbance. The scintillations noted November 26 were very imperfect. The general character of the display was analogous to that of Lancaster Sound, but less intense in illumination, wanting in definition, and having no uniform relation to any quarter of the compass.—Kane's Expedition through Baffin's Bay to the Open Polar Sea, Lat.  $82^{\circ} 30' N$ .

[The following observations were accidentally omitted.]

Cumberland House.—Lat.  $58^{\circ} 56' 40''$  N. Long.  $102^{\circ} 16' 41''$  W. October 23, 1819, to June 18, 1820. Hood.

"January 14, 1820. At ten p. m., Aurora faintly visible north.

19th. An Aurora, embracing the horizon from N. N. W. to N. N. E., about  $12^{\circ}$  high,  $5^{\circ}$  broad; faint, but permanent; twelve p. m.

20th. At eleven p. m., an arched Aurora, centre north,  $15^{\circ}$  high, and  $5^{\circ}$  broad.

27th. At ten p. m., an Aurora  $40^{\circ}$  high and  $5^{\circ}$  broad; usual color, and faint; centre north.

February 2d. An Aurora very faint; centre north, about  $2^{\circ}$  high; extending from east to west.

8th. Appearance of an Aurora, at ten p. m., in the northern horizon.

10th. An Aurora arched, centre N. by E., about  $4^{\circ}$  high and  $30^{\circ}$  long.

12th. At ten p. m., an arched Aurora, centre north, about  $6^{\circ}$  high. Between it and the zenith, were sometimes visible several perpendicular streams, with one extremity pointed, and declining nearly in the direction of the dipping needle. They sometimes reappeared in the same place which they had occupied at first. I shall, for the future, call them flashes.

19th. An Aurora across the zenith, cutting the meridian at right angles. That side of it which faced the south was a regular line; but the other streamed at intervals towards the east or west, separating itself into portions resembling the flashes, but much smaller; color as usual; many flashes near the northern horizon. This Aurora was followed, on the 20th, by a storm of snow E. S. E.

29th. An Aurora arched, centre north, extending  $60^{\circ}$ ; height  $30^{\circ}$ , breadth  $5^{\circ}$ . Towards the eastern extremity, it was broken, by a quick undulating motion, into those portions described above, which I shall call beams, because they appear to tend towards a common centre, though their direction is sometimes altered when in motion. Color as usual.

March 4th. At twelve p. m., a beautiful and singular Aurora; four regular concentric arches, the outermost extending from N. N. W. to E. N. E., about  $30^{\circ}$  high, and the others at equal distances within it, the last being  $7^{\circ}$  high. Each was  $3^{\circ}$  broad; faint, but visible for three hours.

5th. An appearance of Aurora in the northern horizon.

6th. A large, brilliant, arched Aurora, centre N. N. E., at nine p. m. It advanced rapidly to the southward, separating into beams, and scattering many flashes. The motion of the beams was exceedingly quick, and they were bright, but of the usual color. They ranged themselves in wreaths, forming Coronæ Boreales in the zenith, which faded gradually, leaving a pale undistinguished body of light, out of which they were soon again renovated, without apparent communication with any other body of the Aurora.

7th. At one a. m., the above Aurora spread over the whole sky, except a portion from S. S. E. to S. S. W.

At nine p. m., an arched Aurora, centre N. N. E.; many flashes, which, at twelve p. m., filled the northern half of the sky.

8th. An arched Aurora, centre N. N. E. It did not advance to the zenith, but separated into brilliant beams, and scattered many flashes. The motion of the beams was in wreaths, or segments of circles; rapid, and exhibiting at the lower extremities a red-orange color, and at the upper faint yellow.

9th. At eight p. m., an Aurora consisting of several arches, the highest of which was the faintest. They were almost obscured by flashes between them and the spectator.

10th. At nine p. m., an Aurora, in rapid motion, seen through breaks in the clouds.

11th. An Aurora, in many segments, from E. N. E. to W. N. W.; beams in rapid motion; ordinary color.

12th. At eight p. m., an arched Aurora, centre N. by E. At ten p. m., it approached near the zenith, and broke into beams and flashes. Ordinary color.

14th and 15th. Auroræ just visible through the clouds.

16th. A bright Aurora, but almost hid by the clouds.

17th. Aurora visible through a dense haze.

- 18th. At twelve p. m., an arched Aurora, centre N. N. E., about  $20^{\circ}$  high,  $6^{\circ}$  broad, extending from N. W. to E.
- 19th. At eight p. m., an appearance of Aurora in the northern horizon.
- N. B.—From March 22 to April the 8th, the descriptions of the Auroræ and other observations relative to their height, have been delivered in a separate paper.
- April 10th and 12th. Appearance of Aurora north.
- 14th. At nine p. m., an arched Aurora, about  $15^{\circ}$  high; centre north.
- 15th. An arched Aurora,  $16^{\circ}$  high, centre N. by E.
- 16th. Appearance of Aurora N. N. E.
- 19th. At ten p. m., an arched Aurora  $25^{\circ}$  high, centre N. by E., extending from N. E. to N. N. W. At eleven p. m., it was  $35^{\circ}$  high, and its eastern extremity turned back upon itself, and appeared to dart a flash perpendicularly towards the earth. At 11h. 30m. p. m., several flashes reached the zenith. Color as usual.
- 20th. Appearance of Aurora through a thick fog.
- 27th. At twelve p. m., a segment of an arch, and several flashes, north, and about  $30^{\circ}$  high.
- 29th. Several flashes of Aurora bearing north.
- 30th. At eight p. m., an arched Aurora  $30^{\circ}$  high; centre bearing N. N. E., extremities N. E. by E. and N. W. by N.
- May 1st. At twelve p. m., a remarkable Aurora rose from E. N. E. like the trunk of a tree, and spread forth branches all over the sky, but principally towards the south. They were composed of beams, which always are distinguishable when the Aurora is much agitated. Ordinary color; many scattered flashes round the horizon.
- 2d. At eleven p. m., an arch across the zenith,  $6^{\circ}$  broad, and faint; extremes E. by S. and W. by N.
- 3d. At ten p. m., an Aurora in rapid motion, seen through the clouds.
- 5th. At eleven p. m., an arched Aurora, very faint; centre N. N. E.
- 12th. At twelve p. m., the northern half of the sky was filled with a light attenuated Aurora, not more brilliant than the milky way; but flashing with such rapidity that the eye could not follow its motion, nor determine its form.
- 12th. At eight p. m., appearance of Aurora north.
18. Ditto.
- 23d. An arched Aurora  $15^{\circ}$  high; centre N. by E.
- 28th. Appearance of Aurora in the northern horizon.
- N. B.—The above descriptions were taken at the times inserted. The Aurora no doubt often changed its form afterwards. Many of the faint arches, however, altered only their positions in the course of four or five hours, by approaching nearer to the zenith."—1 Franklin (Hood), 543-46.

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Christian's Sound.—Lat.  $60^{\circ} 04'$  N. Long.  $43^{\circ} 00'$  W. October 26, 1828. GRAAH.

"In the evening a beautiful Aurora Borealis displayed itself, in the shape of a bow stretching through the zenith from east to west. It produced no perceptible effect on the magnetic needle."—Graah, p. 48.

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Wonnortalik (Greenland).—Lat.  $60^{\circ} 08'$  N. Long.  $45^{\circ} 16'$  W. March 21, 1829. GRAAH.

"Between nine and eleven p. m., we had a brilliant display of the Aurora, which, particularly towards the south and zenith, exhibited a succession of the most vivid colors."—Graah, p. 58.

**Off Winter Island (Hudson's Bay).—**Lat.  $66^{\circ} 11' 26''$  N. Long.  $82^{\circ} 53' 45''$  W. August 31, 1828. LYON.

"During the night, we saw the Aurora very bright over Winter Island.

It was remarkable that we should have seen it so seldom and faintly at Igloolik, and that now again we should, on returning to Winter Island, find it as brilliant as we had been accustomed to see it at the same place two years before.

The nights were now very cold, long, and dark, and the sea froze thickly when not agitated."—Lyon, pp. 455–56.

## LIST

OF

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**American Magazine.**—A Monthly Miscellany, conducted by Horatio Gates Spafford, A. M., F. A. A. Albany, N. Y., March, 1816.

**Arctic Miscellanies.**—A Souvenir of the late Polar Search. By the Officers and Seamen of the Expedition. A MS. Newspaper, called "The Aurora Borealis," published on board H. M. S. Assistance, Captain Ommaney, 1850-51. London, 1852.

**Austin.**—Report of Proceedings of Arctic Searching Expedition, under command of Captain Austin, R. N.

**Austin.**—Report of H. T. Austin, Captain of her majesty's ship Resolute and in charge of an Expedition to the Arctic Seas in search of Sir John Franklin, 1850-51. Inclosing Reports and Journals of Proceedings of Searching Parties acting under his orders.

**Back.**—Narrative of the Arctic Land Expedition to the mouth of the Great Fish River, and along the shores of the Arctic Ocean, in the years 1833, 1834, and 1835. By Captain Back, R. N., Commander of the Expedition. London, 1836.

**Beechey.**—A Voyage of Discovery towards the North Pole, performed in his majesty's ships Dorothea and Trent, under the command of Captain David Buchan, R. N., 1818. By Captain F. W. Beechey, R. N., F. R. S., one of the lieutenants of the Expedition. London, 1848.

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**Belcher.**—Proceedings of the Squadron in the Arctic Seas, under the command of Sir Edward Belcher, C. B. August, 1852, to July, 1853.

**Belcher.**—Narrative of Sir Edward Belcher; detailing his visit to Jones's Sound, and further proceedings to the 10th of November, 1853, when the "Assistance" was frozen in near Cape Osborn in the Wellington Channel. And his further proceedings to March, 1854, and August, 1854.

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**Cartwright.**—A Journal of Transactions and Events, during a residence of nearly sixteen years on the Coast of Labrador. By George Cartwright, Esq. In three volumes. London, 1792. 4to.

**Chappell.**—Narrative of a Voyage to Hudson's Bay in his majesty's ship Rosamond; containing some account of the Northeastern coast of America, and of the Tribes inhabiting that remote Region. By Lieut. Edward Chappell, R. N. London, 1817.

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